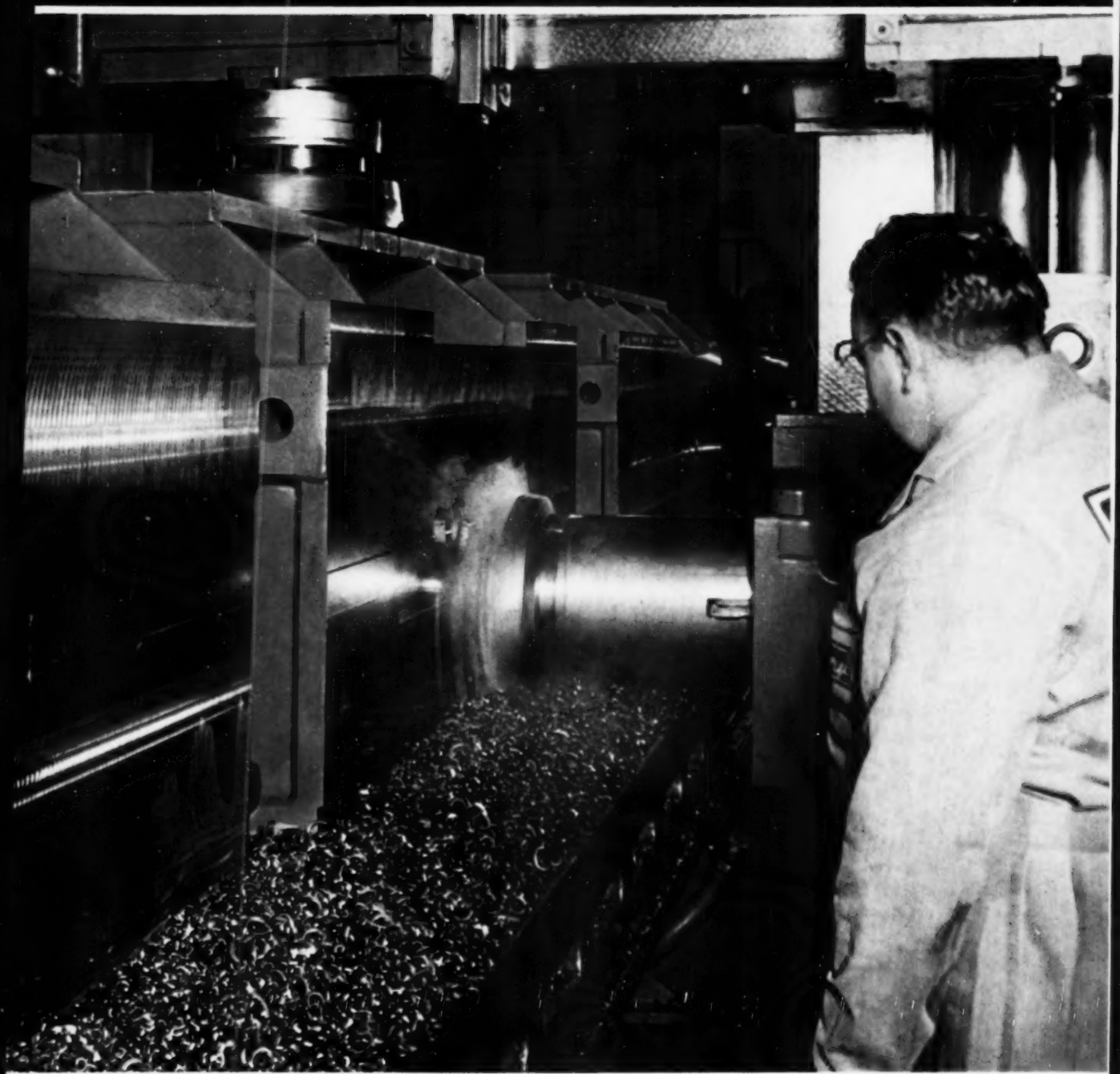
American Machinist

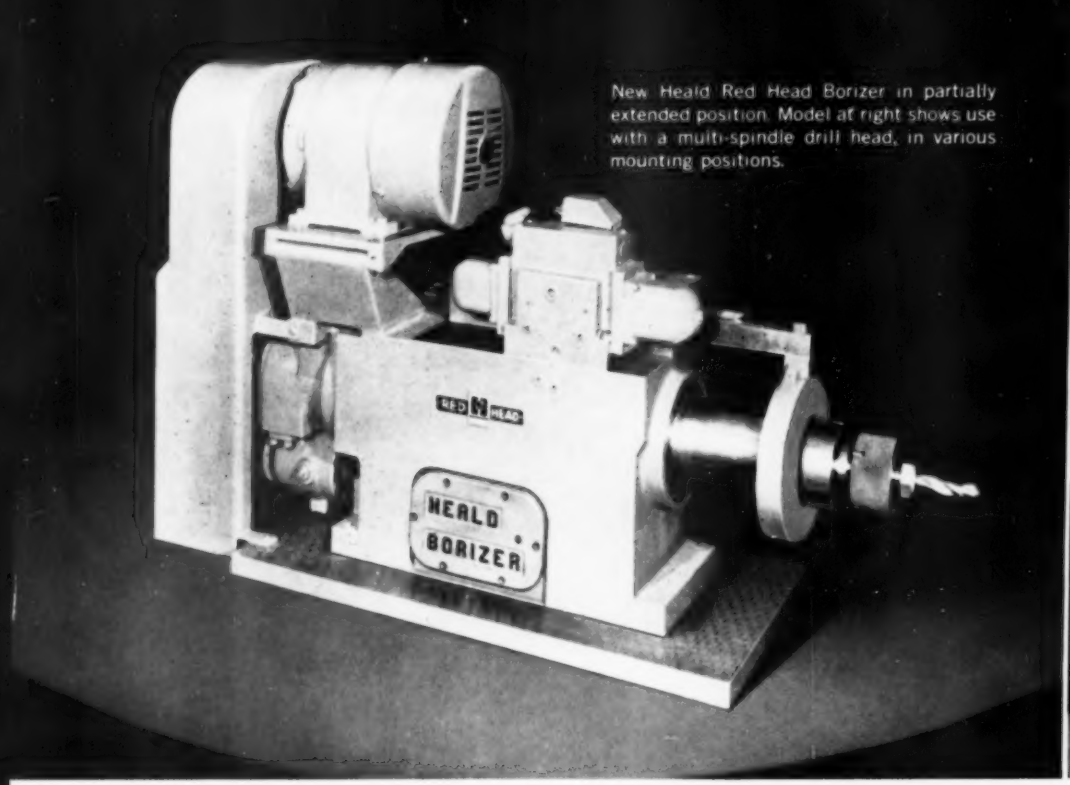
MARCH 9, 1959 75¢

McGRAW-HILL MAGAZINE OF METALWORKING PRODUCTION

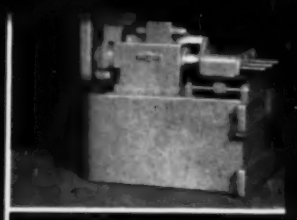
Let's take the
GUESSWORK
out of
INSPECTION
see page 117

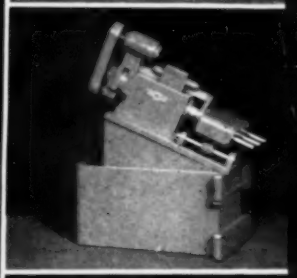


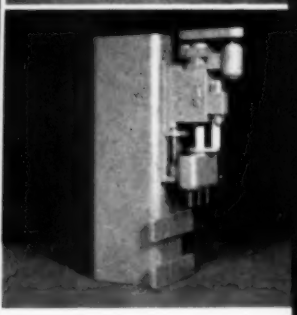
Five building-block bases milled in one setup— see page 126

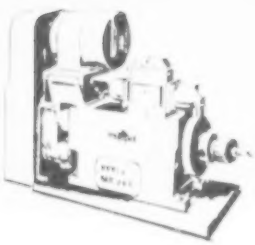


New Heald Red Head Borizer in partially extended position. Model at right shows use with a multi-spindle drill head, in various mounting positions.









Presenting the new Heald

BORIZER

Another **NEW** PRODUCT *by Heald*

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A completely self-contained unit for rotating and feeding single or multiple tools in automated setups

Designed primarily for driving multiple-spindle drill units, it rotates tools and can supply its own hydraulic power. It feeds tools in to the work at any desired rate and rapid traverses out when the operation is done. In short, the new Heald Red Head Borizer can do just about any drilling, reaming, counterboring, chamfering, and plunge facing operations. Under conditions consistent with its design and purpose it is also capable of boring operations similar to those performed on Heald Bore-Matics.

Its compact design permits grouping a number of units in a variety of positions on a single base machine or along an automated line. And its compact, self-contained construction simplifies relocation for job changeovers. Note also that this unit can be mounted horizontally, vertically or at any desired angle.

Heald Red Head Borizers incorporate the basic design and specifications of precision Red Head Boringheads and are available in four sizes, with strokes of 8, 10, 12 or 15 inches. An adequate thrust range is available for multiple drilling operations. Easily accessible dogs control cylinder stroke and adjustable valve gives infinitely variable feed rates within the feed range. The unit may be operated with integral or central hydraulic systems or with integral or centralized electrical controls.

Ask your Heald engineer for further details, or send for a copy of Bulletin No. 5-2, Issue 1.

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TRENDS

Metalworking Report . . 2
Spot News . . 85
Washington . . 87
Detroit . . 89
Aircraft and Missiles . . 91
Machine Tools . . 93
Materials . . 95
What's Ahead . . 97
Field Report . . 182

Departments...

Letters . . 78
Calendar . . 81
Editorial . . 101
Talking Shop . . 141
Memos . . 141
Practical Ideas . . 142
New Equipment . . 145
Names . . 213
New Books . . 216

contents for March 9, 1959

VOLUME 103, NO. 5

Breaking the cost barrier on Precision 3 gears . . . Until now, AGMA Class 2 and 3 precision gears were usually obtained by selection and segregation. Now PIC Design Corp is regularly hobbing gears to these tolerances... **103**

APT—the language that commands machine tools . . . New system uses language to program machine tools, can reduce the time spent in programming by spectacular amounts. **106**

Precision hex tubes require special techniques . . . Reactor tubes require such close tolerances that Argonne developed its own method. *By Herbert V Ross and Alexander A Denst, Argonne National Laboratory*..... **108**

"We made these machines ourselves" . . . Five simple machines for highly specialized jobs at Friden. *By George H DeGroat.* **111**

Electron-beam machining . . . Here are the first details on how this "ray gun" process, previously described for welding, can be applied to precision machining of almost any material..... **115**

Let's take the guesswork out of inspection . . . Is there a practical way to draw the line between acceptance and rejection? Yes, and here it is. *By Jack S Gantt, General Electric Co.* **117**

How to correct your employees . . . A three-step procedure that makes the bawling out both palatable and effective. *By H E Carroll*..... **123**

These plastic tools saved money . . . Cast and laminated epoxy tools save tooling time, fabricating cost, weight, and repair effort. *By J Bruce Ferguson, Allis-Chalmers Mfg. Co.*..... **124**

Modernization and building-block design . . . cut costs on special machines. Here's how individually designed components were eliminated. *By George H DeGroat.* **126**

Small shop drills 10,000-hole plates . . . Surveyor's transit attached to radial drill aids setup. *By A F Bartsch, Bartsch Tool Corp.* **128**

Electronic millers speed airfoil machining . . . No. 1 makes the templet from the drawing, No. 2 makes the part from the templet at Solar Aircraft Co. *By George H DeGroat.* **130**

REFERENCE BOOK SHEETS

Feed per tooth in milling . . . A nomogram to determine feed per tooth when you know table feed, cutter speed, and number of teeth. *By Tyler G Hicks*... **135**

Torsional loads on shafts . . . Nomogram solves torque and shear stress when diameter is known. *By Michael M Lachowski.* **137**

Machine Tapers, IV . . . Dimensional data on Morse stub tapers..... **139**

METALWORKING REPORT

SIGNIFICANT CURRENT DEVELOPMENTS IN TOOLING AND PRODUCTION PROCESSES

COVER:
Gray planer-miller with duplex tables at Buhr Machine Tool handles five machine bases on each table, with two simultaneous cuts. Page 126.

CUTTING

Precision Gears to Order

Class 3 gears, usually achieved by selection and segregation, are now being produced on a daily basis by PIC Design Corp. This has been achieved by the combination of new hobbing machines designed for precision work, careful blank preparation, and a practical-but-precise set of workholders. The hob is trued to less than 0.0001 in. before the job begins, and blanks are within 0.0001 in. both for concentricity and runout. A more detailed description of the process is in the article on page 103.

Formed Work Centerless Ground

By use of a crush-formed wide wheel it is possible to grind formed parts from the solid to close tolerances.

The operation normally starts with heat-treated stock cut to length. Typical uses are nozzles for fuel injectors, aircraft fasteners, taper rollers, necked-down shafts, and grooved parts. Exceptional roundness and close tolerances are assured because the regulating wheel supports the piece while it is being ground.

One use of Van Norman Machine's "Diversimatic" centerless grinder is making a necked-down bar 5¼ in. long. The customer considered two methods: (1) a screw-machine operation that would finish the necked-down portion (0.200-in. dia) and centerless grind the 0.380-in.-dia ends, and (2) a three-operation sequence involving through-feed grinding to remove surplus material, centerless grinding of the necked-down portion and adjacent radii, and finish-grinding of the entire part with a diamond wheel.

The job can be done in two operations. Heat-treated stock is rough ground in 18 sec. by the crush-dress method, leaving 0.010 in. for finishing operation in 9 sec., to eliminate any possibility of runout. A ½-thousandth tolerance is held all over.

Electron-beam machining

Concentrated beams of X-rays may become important as a machining technique. Present equipment can cut a clean-edge slot only 0.0015 in. wide through the toughest material. With tape control, the machine will cut extremely accurate and intricate profiles.

Electron beams already show promise as a contamination-free method of welding (*AM*—Feb 23 '59, p95). The Carl Zeiss cutting unit is built along the same lines as the welder, but it concentrates the beam of electrons into a much smaller spot; and it raises the energy concentration to a level where the work is vaporized instead of merely melted.

Both welding and cutting machines stem from the electron microscope. Zeiss is using an electron-beam drill to pierce jewels for instrument bearings. The beam vaporizes a hole 0.001 to 0.010 in. in dia within a tolerance of ±0.0007 in. See page 116.

Tape for Valve Bodies

First reported application of magnetic-tape path control outside the aircraft industry is getting under way at Gray Tool Co, Houston, Tex. A vertical boring mill with tape control is being used for contour machining of valve bodies. See page 146.

Machines That Listen

APT, a 107-word language developed by MIT for the Air Force, is a new, vital link in translating engineering drawings into actual operation of numerically controlled machine tools. Sample: "ON KUL, ON SPN, GO RGT, TL LFT" means when translated onto a tape "Turn on the coolant, turn on the spindle, go right with the tool. . ." In effect, APT takes programming out of the highly-specialized-work category, puts it on a-shop-man-can-do-it level. (See pp91 and 106.)

FORMING

Precision Sheet-metal Tubes

Long hexagonal tubes made of thin stainless steel had tolerances so close that suppliers weren't interested in bidding o nthe job. But Argonne National Laboratory solved the problems and fabricated the required 10-ft tubes for a nuclear-reactor core.

The material was 0.043-in. stainless (Type 304), and the tubes were 2.875 ±0.005 in. across flats. Twist and longitudinal straightness had to be held within 0.015 in. per 3 ft of length.

Argonne fabricated them from flat sheets, precisely trimmed and scored for forming. After welding, the tubes were externally sized and internally burnished for dimensional accuracy. See page 108 for details of tooling and technique.

Titanium Shaped for Missiles

A one-piece rocket motor head and casing for an advanced-style missile is now being turned out by Titanium Fabricators, Inc, Burbank, Calif. The missile closure is made of titanium; appears to be a domed tank end about 26 in. dia by 16 in. high by ⅜ in. thick, and with a low crown of large radius. Bosses are now formed in a secondary operation, but experimental work is being done to incorporate the bosses concurrently with forming of the head and casing.

Process used is roll-flowing on a vertical machine (*AM*—Dec. 2, '57, p141). Titanium Fabricators built machine, which is limited to parts 37 in. dia and less than ½ in. thick in steel. Larger machines are planned for parts up to 70 in. dia

by 1 in. thick. Several passes are required.

Operating temperatures vary with metal being formed. Some titanium alloys require 1300 F, the maximum available. Ductile-iron tooling is heated electrically. Lubricant, not disclosed, is applied to the work material before forming.

The roll-flowing machine has a floor-mounted table with rotating chuck, like a boring mill. A hinged yoke with powerful hydraulic cylinder at mid-point swings over the work, forcing the rolls against the metal. Feeds, speeds and pressures are controllable. The hydraulic system is rated at 3000 psi.

Safety Ring Saves Fingers

Safeguard of kick presses and pneumatic bench presses is a difficult problem. In watchband work, for example, finger injuries are likely to be common because small parts must be held and manipulated virtually under the tooling.

A sensing device that will not let the ram apply full pressure if a finger is in the way is now in use. A ring guard surrounds the ram or forming tool. This guard is connected to the press master air cylinder.

The ring guard, developed by Liberty Mutual Insurance Co, descends with enough force to rap the finger lightly. With the finger present, the ring guard cannot descend to uncover the main port in the master air cylinder. If no obstruction is encountered, the power stroke is completed. A watchband manufacturer has already equipped 175 presses with the new safety device.

Convert to Impact Molding

To facilitate the rapidly developing use of sequential impact molding, the Fellows Gear Shaper Co has developed a conversion kit which makes this kind of molding practical on its conventional injection-molding machines for plastics. It is understood that the kit can be used to convert injection molders of other than Fellows design.

HEAT TREATING

Closer Alloy Hardness Control

Many structural alloys derive their strength from minute ferromagnetic particles of other phases dispersed throughout the metal, but a full understanding of this particle hardening process has been complicated by size of the particles—they may contain only a few thousand atoms each.

Taking advantage of the magnetic behavior of these fine particles, General Electric's research laboratories have been able to determine the sizes, shapes, and number of particles present in such alloys, and even the change in particle shape as the alloy is deformed. GE sees this research as clarifying the role that particles play in hardening of alloys and as a step toward precise strength control in this type of alloy.

Multi-Purpose Electric Furnace

Designed for investigative and pilot runs as well as short-run production and heat-treating small parts, the Thermolyne 2100 furnace, a product of Thermo Electric Mfg Co, Dubuque, Iowa, is a top-loading electric furnace that is adaptable to salt bath, melting, vertical muffle, or crucible furnace operations. Maximum chamber temperature for intermittent operation is 1900 F. This low-cost unit should find wide application in laboratories or shops that cannot purchase several furnaces of different types, or where space limitations dictate use of a single furnace.

INSPECTION

Will Gages Repeat?

The ability of a gage to repeat its measurement should be within 10% of the tolerance spread, say the gaging experts. If the gage can't work within this narrow band, you may have trouble with borderline cases. Some parts just over the limit will be accepted; some just inside that limit will be rejected.

The question is: "How can you be sure that a gage will operate within the prescribed repeatability limit?" Besides, "Will the gage function properly in the hands of various operators?"

General Electric at its Evandale, Ohio, plant has pioneered a simple system for checking gage repeatability and operator bias. A form (see page 118) is based on statistical analysis, but does not need technical people to find the answer.

That's not all. Experience in using a new system is important. The method has been in use long enough to enable listing a number of observations on how the information developed can be interpreted and applied. See p117.

THE OUTLOOK

Steel production, spurred by inventory buying against a possible July strike, will be close to full capacity in second quarter. Output of metal products will go up more slowly. All segments of metalworking are likely to show improvement as the year goes along. *See page 97.*

ASSEMBLY

Dial Boosts Simple Assembly

Retooled Bodine multi-station dial machine at Minneapolis-Honeywell inserts and crimps two brass terminals and two screws into each of 1500 terminal blocks for transformers per hour. Terminals feed in as partly formed coiled strips; screws feed from vibratory hoppers. Mechanized spindles tap the terminals and drive the screws. Automatic inspection is included; pins are depressed over screws; overtravel indicates a miss, which triggers reject mechanism. One operator is required, as compared to several with old kick-press and benchwork system.

FINISHING

Stop Plating Corrosion

Anode hooks and work baskets made from pure titanium by Mallory Sharon look like the answer to corrosion problems in nickel and chrome plating. Standard anode hooks are available in sizes from 3½ to 8 in., and baskets in all standard sizes. They are claimed to have a virtually indefinite life in highly corrosive mixtures.

Particular advantage of the titanium hooks is that they may be submerged beneath the surface of the acid. This means even dispersion of the nickel and sharply reduces the scrap loss in anode ends.

New Finish for Stainless

The highly reflective surface commonly associated with stainless-steel trim is not always completely desirable. A white, frosted finish is now being produced by a process called "Fro-Zon," developed by Stamping Service Inc, Detroit. Details have not yet been made available, but the process is understood to be a type of "semi-blasting" which produces tiny mounds on the metal surface. The finish is applied after forming, and there appears to be no limit to the shape of the work or to the pattern applied.

Thus far, work has been restricted to automotive trim in Type 430 stainless, but the process opens up inter-

esting fields for decorative treatment on appliances, cooking utensils, furniture, and in architectural use. It appears to be unaffected by extremes of temperature or weathering. Still under development is a process for adding color to the frosted surface.

MATERIALS HANDLING

Magnetic Handling, Soviet-Style

Russian engineers have developed an improved magnetic grip for handling heavy metal loads, according to Wodny Transport, a Soviet publication. The improvement consists of four vertical "legs" fitted to the magnet's frame. Attached to the lower ends of the legs are horizontal braces that swing 90°.

Previous magnetic-grip devices warmed up unduly when the electromagnet had to work over long distances. The new magnet raises the work load high enough for the horizontal braces to swing in under the load. Depending on the load, the magnetic force then can either be shut off or the electric charge to the magnet can be reduced. Results: less electric power required, practically no heat generated.

Application of the device in US plants could facilitate heavy handling in many respects. But whether it will conform to American safety codes is questionable.

Brainy Package Buncher

A conveyor system that can automatically sort 1200 different-size cartons per hour is now in operation at a Philco Corp plant in Philadelphia. Installed for warehousing of packaged TV sets, the system is pushbutton-controlled by only one operator.

Heart of the automatic sorting operation is a "memory" system, incorporating magnetic disks, that directs cartons from the main conveyor to any of 17 storage lines. When a carton passes the operator he pushes a button that causes the carton to be "identified" on one of the disks (which are mechanically linked to the conveyor drive). When the carton reaches the storage line that has been assigned it by the message to the magnetic disk, the disk is "read out" by a sensing device and the carton is shunted onto the storage line.

MATERIALS & COMPONENTS

New Comparator Mirrors

Use of a new, highly reflective mirror coating, believed to be aluminum, has increased the screen brightness on all Jones & Lamson comparators by 64%. No increase in price has resulted from the change.

Vanadium Sheet Coming

A series of Vanadium alloys has been produced successfully for the first time. Developer is Armour Research Foundation. Now a range of vanadium sheet—not just bars and shapes—is possible. Main advantages of vanadium alloys are: (1) extreme workability—can be cold worked over 98%, comparable to highly malleable gold's 99%+, (2) strength—while a middleweight among possible aircraft structural metals, it has a strength-to-weight ratio which is superior to, for example, titanium, (3) good weldability. Alloys retain their strength at temperatures of 1200 to 1500 F. Armour has been principal center of vanadium alloy development in the US.

Leaded *alloy* steels

Increasing demand for better, and more consistent, machinability characteristics is causing a major steel producer to increase its production of leaded steels. While leading has a widely recognized value, it is most significant that the greater emphasis will be on leaded *alloy* steels, especially some of the higher alloys which have not, heretofore, been available with a lead additive.

Ceramic Ball Bearings

Pyroceram has been used to manufacture ball bearings by its developer, the Corning Glass Works. Entire bearing, balls and races, except the retainer, is machined from this glass-like ceramic material. Said to offer about one-third the strength of a conventional metal ball bearing, the Pyroceram bearings operate very satisfactorily at 1100 F and, of course, are practically inert to corrosion and chemical attack.

Tests now underway will show capabilities with and without lubrication. In addition to the missile field, uses are expected to develop in chemical equipment, food machinery, and electrical equipment—the latter because of the material's insulating qualities. Cost of the bearings may be less than for some of the more expensive special metallic bearings.

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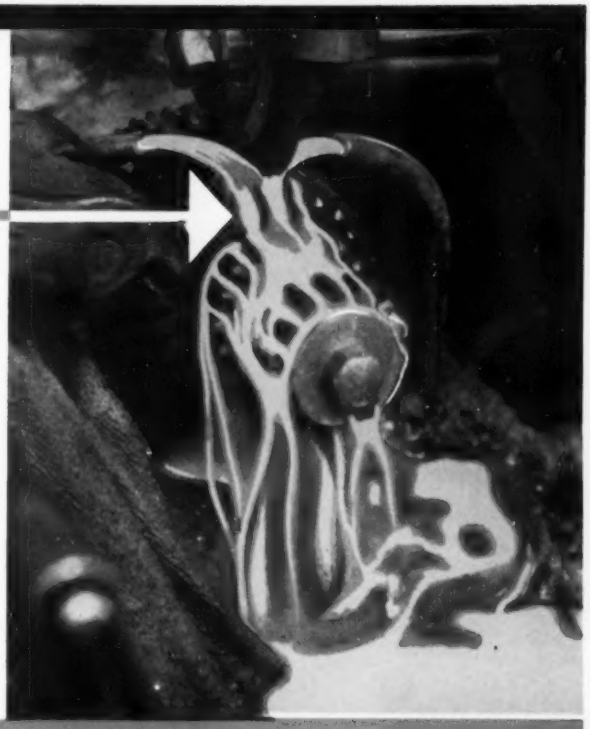

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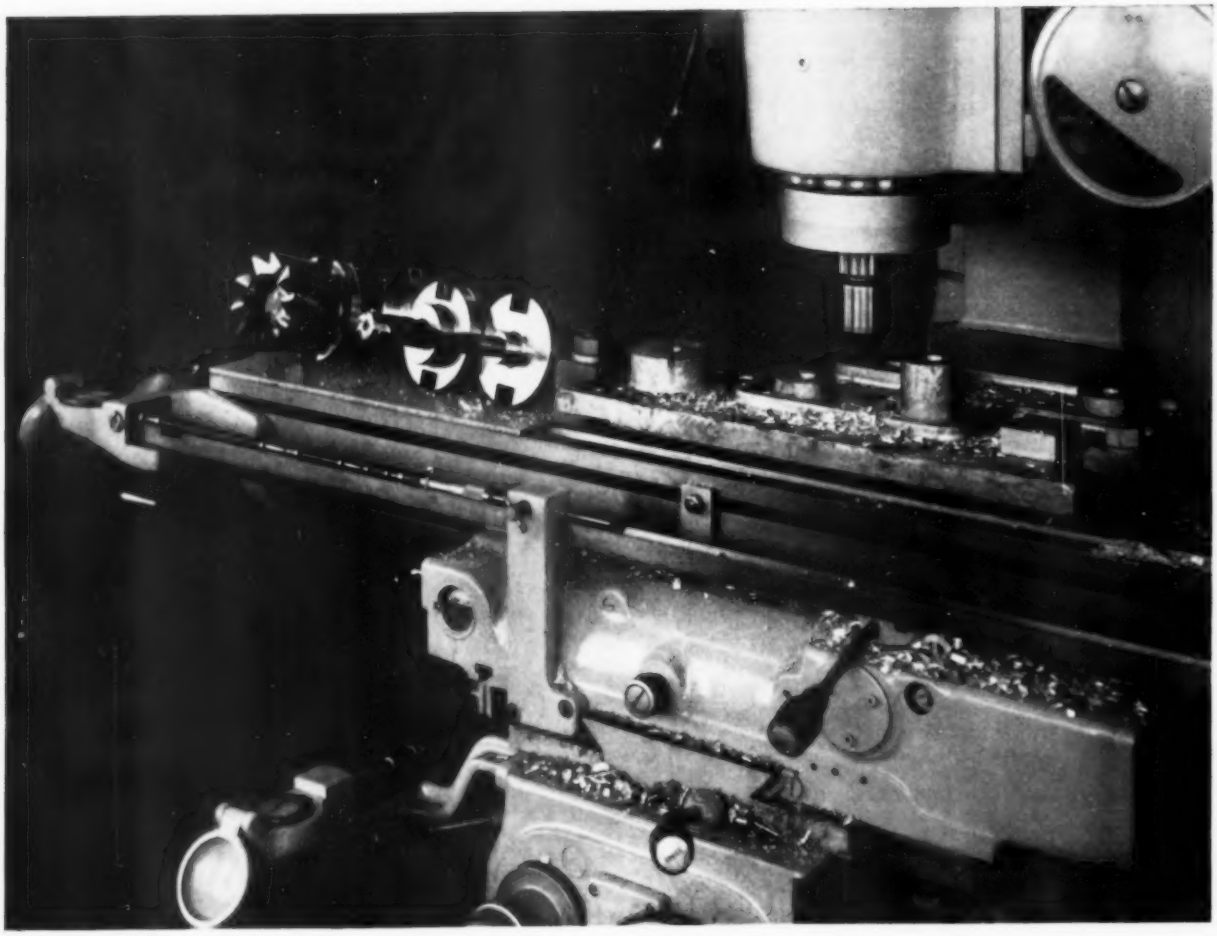

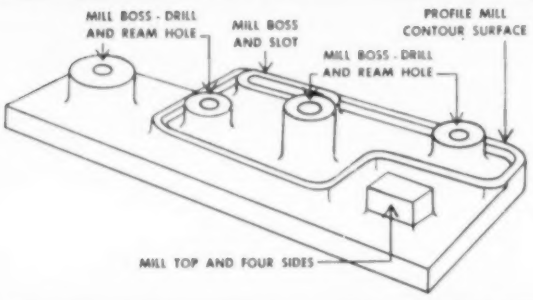
MILL BOSS - DRILL AND REAM HOLE
MILL BOSS AND SLOT
MILL BOSS - DRILL AND REAM HOLE
PROFILE MILL CONTOUR SURFACE
MILL TOP AND FOUR SIDES

Several operations, indicated in the drawing at the left, are completed in one setting of the work on a new CINCINNATI No. 2MI Vertical Milling Machine. Cutters for the various operations are changed in a few seconds, an exclusive CINCINNATI ARBOR-LOC advantage.

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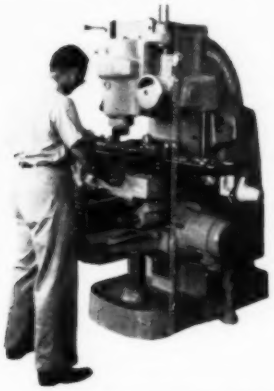
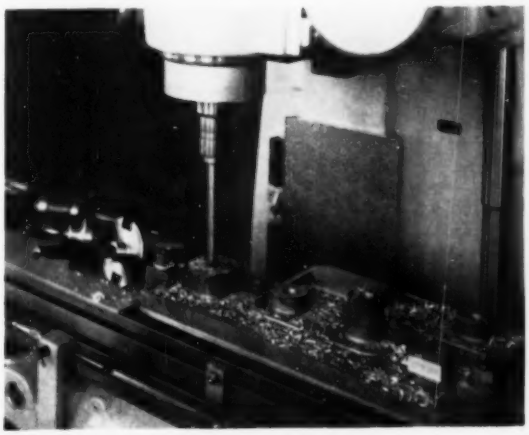
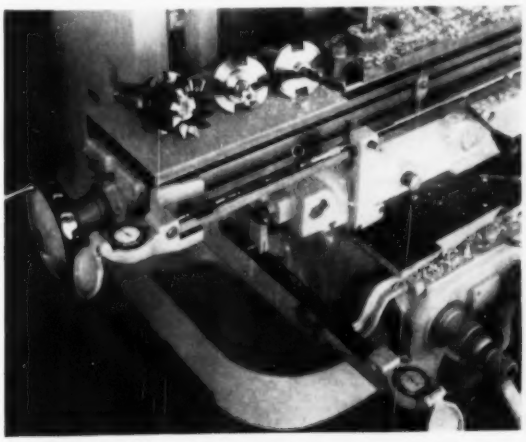


CINCINNATI No. 2MI Vertical Milling Machine. Also available in Plain and Universal styles, and 2ML Plain and Universal. Catalog No. M-1995-2.

ARBOR-LOC is the big timesaver illustrated here. Cutters are changed in a few seconds.



Power feed to the head is a useful feature-advantage for this type of work . . . boring the holes.

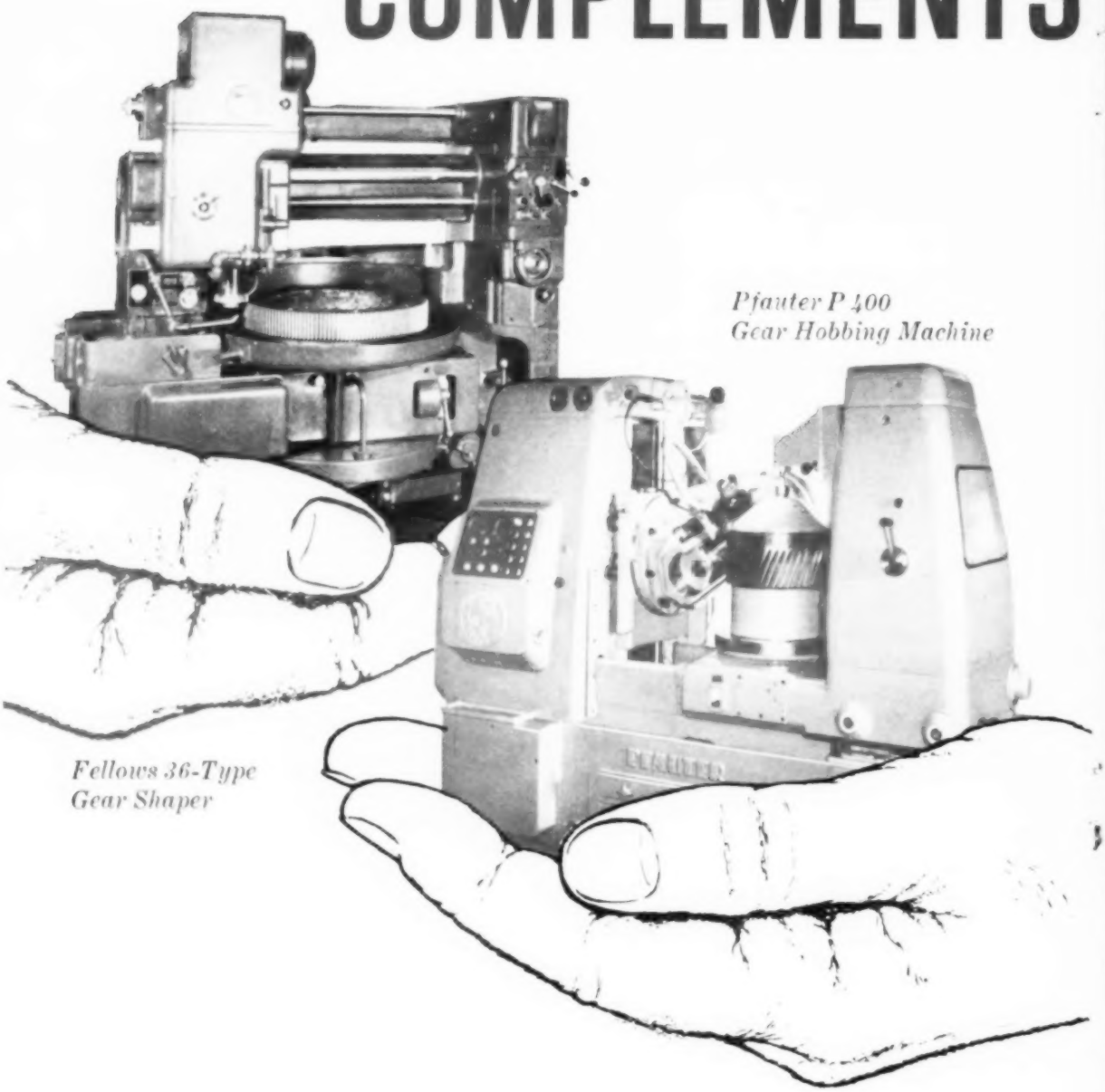


Precision Measuring Equipment (slight extra cost) facilitates table and cross positioning for accurate spacing of machined surfaces and holes.

DIE SINKING MACHINES • CUTTER AND TOOL GRINDERS

MILLING MACHINE DIVISION
The Cincinnati Milling Machine Co.
Cincinnati 9, Ohio

PERFECT COMPLEMENTS



Pfauter P 400
Gear Hobbing Machine

Fellows 36-Type
Gear Shaper

THE
PRECISION
LINE

. . . ✓ FELLOWS GEAR SHAPERS!
✓ PFAUTER GEAR HOBBERS!

Now Fellows sells, and later will manufacture, the world-famous Pfauter Gear Hobbing Machines and Worm Milling Machines.

Fellows Gear Shapers and Pfauter Gear Hobbers provide complete coverage of modern gear production equipment needs. Both operate on the molding-generating principle. The Pfauter Hobbers embody every important advance in hobbing technique, in most cases originated by Pfauter. And Fellows Gear Shapers incorporate every major advance in gear production by the Gear Shaper method originated by Fellows.

Among the many features incorporated in Pfauter Hobbers are the differential for helical gear hobbing, the hydraulic backlash eliminator for efficient climb hobbing, the fully automatic plunge for longitudinal and radial-tangential hobbing and, most recently, exclusive Pfauter DIAGONal Hobbing. Capacities of Pfauter machines range from 3" max. P. D., $2\frac{3}{4}$" max. face width, to 120" max. P. D., $1\frac{1}{4}$ D. P. and 30" max. face width.

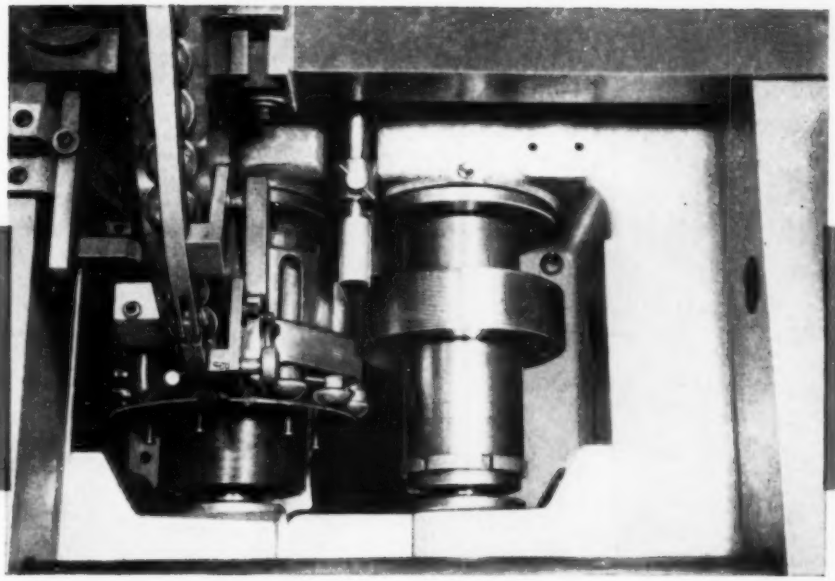
With the addition of the Pfauter line, Fellows provides the most comprehensive service possible in the field of gear production equipment. Your Fellows representative can give you full information about our machines and instruments which cover every phase of gear production.

THE FELLOWS GEAR SHAPER COMPANY
78 River Street, Springfield, Vermont
Branch Offices: 1048 North Woodward Avenue, Royal Oak, Mich.
150 West Pleasant Avenue, Maywood, N. J.
5835 West North Avenue, Chicago 39
6214 West Manchester Avenue, Los Angeles 45

Fellows *Gear Production Equipment*

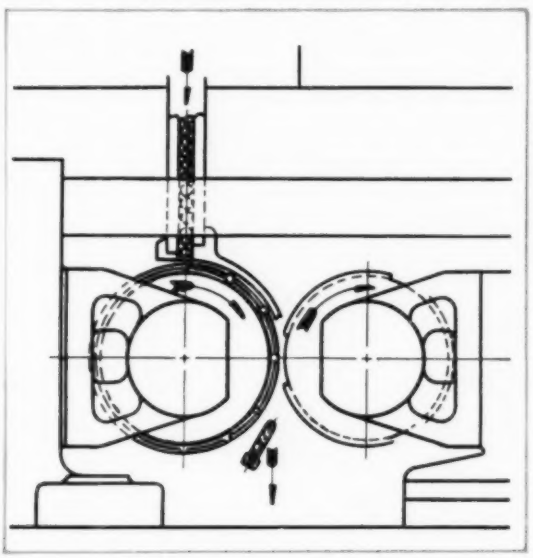
AUTOMATED THREAD ROLLING

with the LANHYROL machine



The automatic features of the LANHYROL Thread Rolling Machine have enabled a large industrial fastener and related parts company to automate its process for producing button head oval neck track bolts. ¾" 10 pitch UNC threads are rolled 1¾" in length to Class 2A fit.

One man now handles the entire operation, eliminating difficult and costly handling of hot-forged bolt blanks required in the old process. Now . . . bolt blanks are cold-formed from 800-lb. coils of hot-rolled steel wire by passing through a wire-drawer into a two-blow header, conveyed to a hopper, threaded by Continuous Rolling on the LANHYROL Machine, and ejected as finished parts into a bin for removal.



Continuous Rolling (illustrated) is one of three thread-rolling methods utilized by the LANHYROL Machine. Blanks are delivered from a hopper to an automatic, indexing-type workrest. This indexes the pieces according to a preset cycle into and away from the rolling position. There, thread-rolling is accomplished by two opposed cam-type rolling dies.

Although the LANHYROL is capable of rolling 80 track bolts per minute, in this application it is only operated to slightly exceed the production rate of the header which is 60 blanks per minute. Thread finish is considerably improved over previous methods and roll life is excellent . . . more than ¾ of a million bolts have been threaded to date with the original roll dies.

The LANHYROL Machine produces excellent threads at unequalled rates of output, and its method of operation fits well into automated processes. For information on its unusual range and flexibility, and the Infeed and Thrufeed thread rolling methods, send specifications and ask for Bulletin E-60.

493C

LANDIS *Machine* COMPANY

WAYNESBORO • PENNSYLVANIA • U. S. A.

Low cost Landis Grindwell gives

... exclusive features permit quick setup... assure precision tolerances

for: manufacturing / maintenance / toolroom grinding

Landis 12" x 28" Grindwell

LANDIS

precision grinders

LANDIS TOOL COMPANY

"big grinder" performance

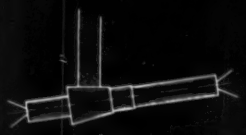
Exclusive Feature: Variable speed headstock . . . compact design with only two revolving parts. Can be swiveled for angle or face grinding.

Exclusive Feature: Microsphere bearings . . . close running clearance of Landis Microsphere bearings gives faster spark-out, accurate, quick response to wheel feed.

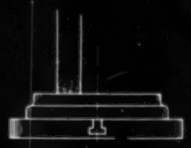
WAYNESBORO, PENNSYLVANIA

typical grinding operations

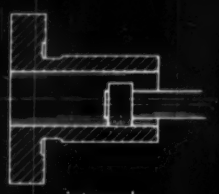
straight cylindrical



taper



face and angle



internal

CIRCLE 179 READER SERVICE CARD

MORSE
"TOOLMASTER"

The MORSE Team is the TOP T in the Cutting Tool

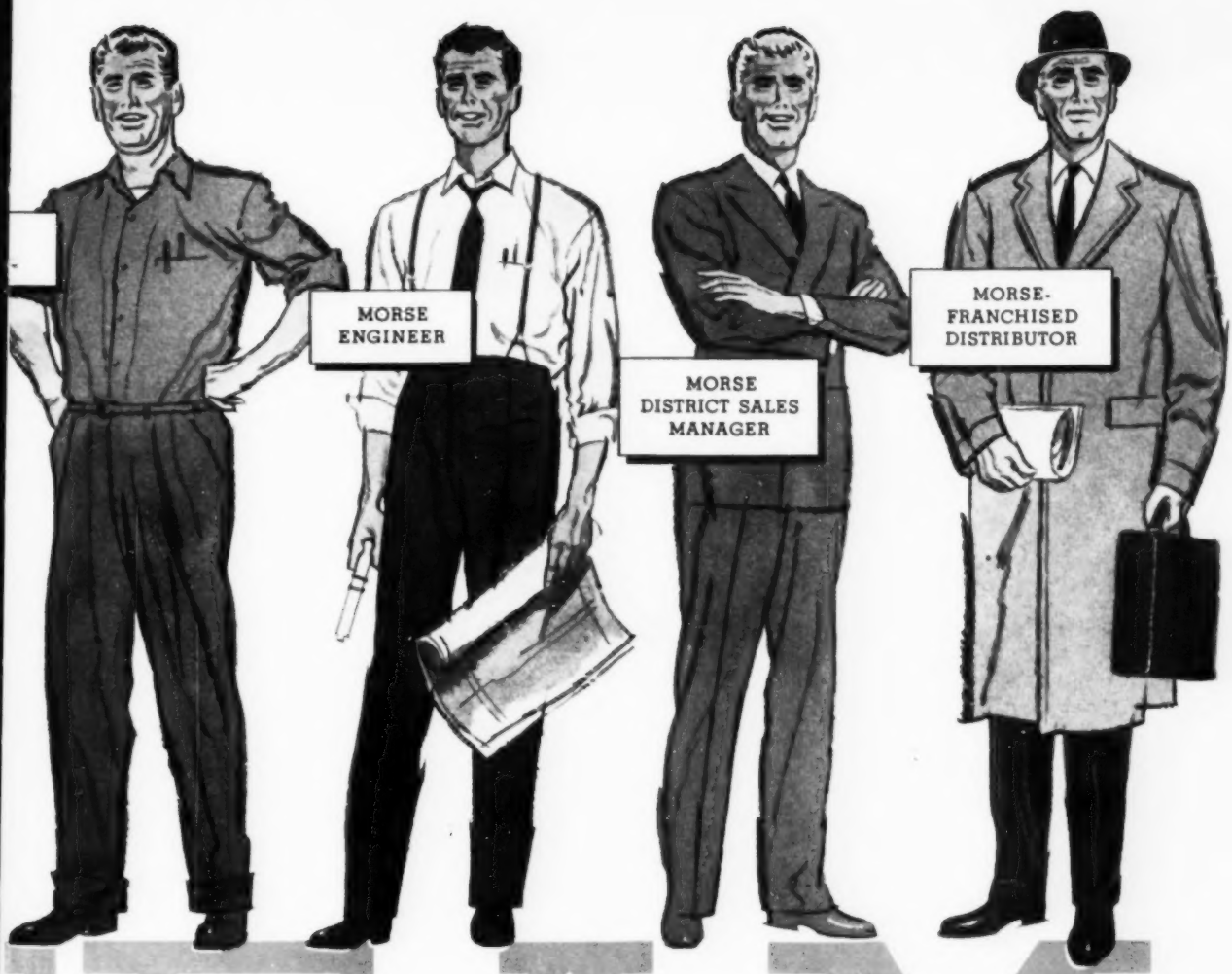
...make them part of your team!

Here are the four hardest-hitting "linebackers" in the cutting tool industry . . . good people to have on *your* side.

From them you get *the most* in design, quality, service, and know-how in fitting the product to the job.

Yes, if you want *the most* for your cutting-tool dollar, mark that order MORSE.

And call your Morse-Franchised Distributor *today*.

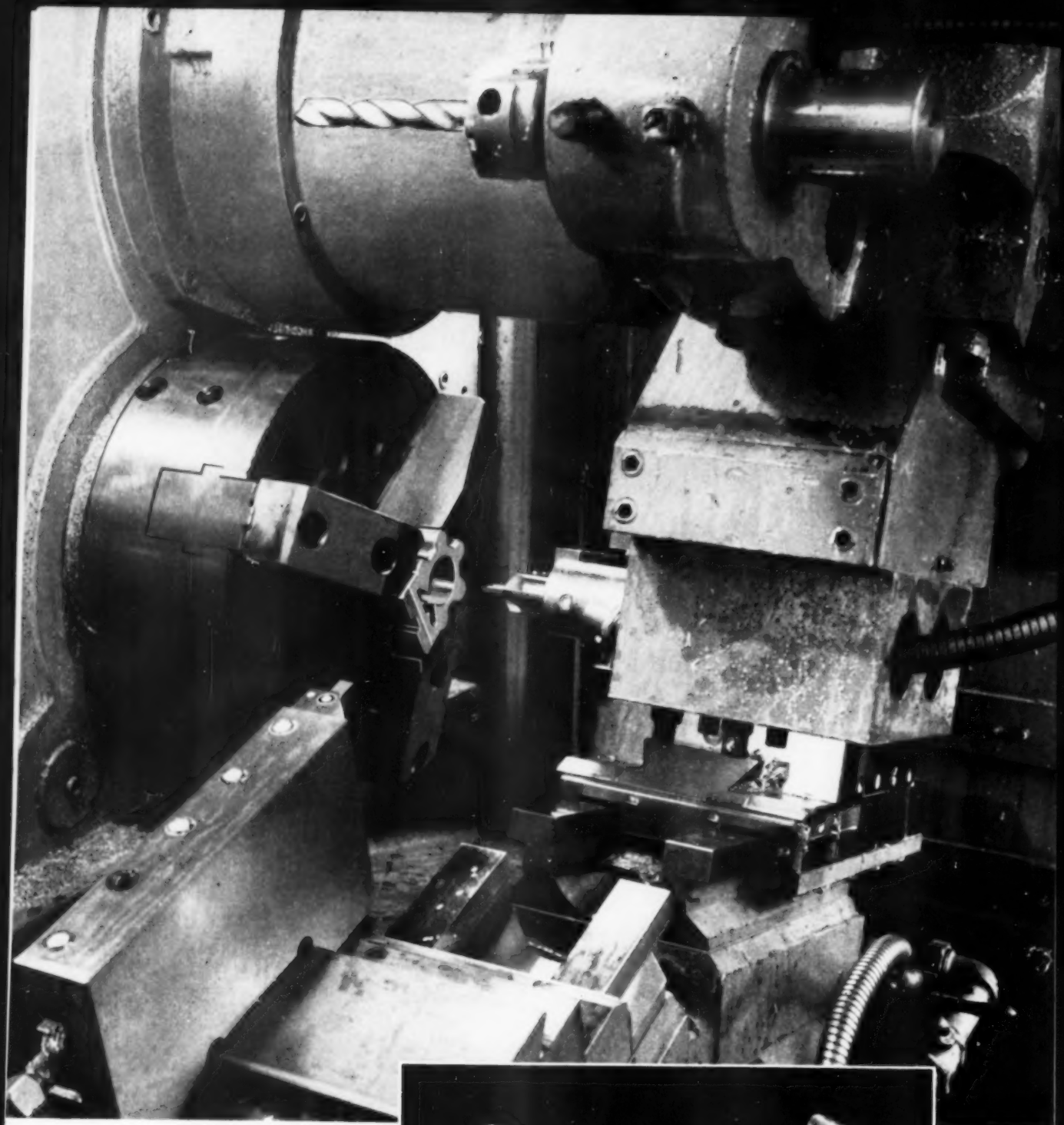


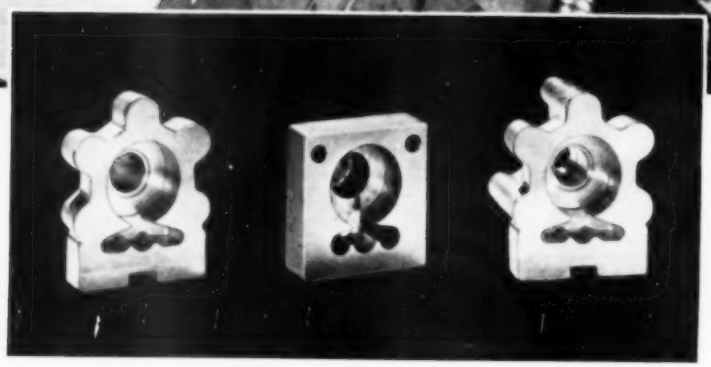
TEAM

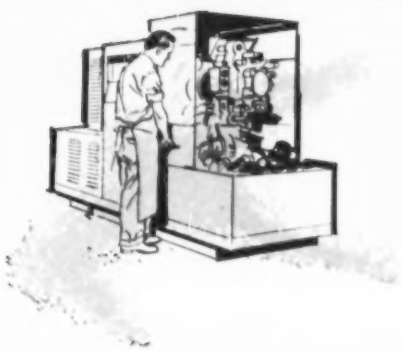
Industry

MORSE TWIST DRILL & MACHINE COMPANY
New Bedford, Massachusetts
A Division of VAN NORMAN INDUSTRIES, INC.
Warehouses in New York, Chicago, Detroit, Dallas, San Francisco

MORSE means "THE MOST" in Cutting Tools







CIRCLE 182 READER SERVICE CARD

At Eco Engineering Company

NEWARK, NEW JERSEY

Pump parts with Missile grade accuracy now produced on production basis

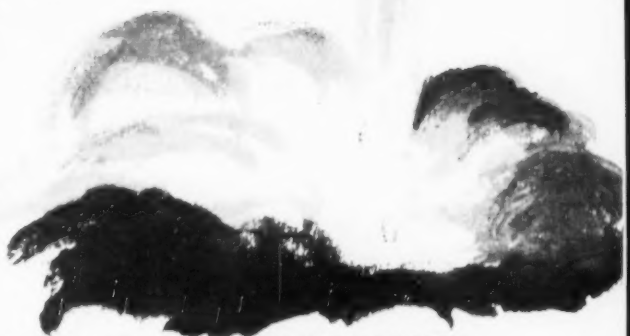
As a result of Eco's installation of two Warner & Swasey 2AC Chucking Automatics, the chemical process industry has, for the first time, a wide selection of standard stock pumps at production prices. Formerly, high-cost custom-built units were always used.

Moving highly corrosive and/or hazardous liquids is routine for Eco's small rotary displacement and centrifugal pumps. For example, the successful Vanguard II Rocket was fueled at Cape Canaveral with an Eco pumping unit.

To meet these extreme safety and accuracy requirements demands precision machining of nickel alloy materials and austenitic stainless steels—both extremely difficult to machine because of their work-hardening characteristics. Their Warner & Swaseys offer definite advantages by providing extreme rigidity and constant tool feed pressures.

Because pump capacity and volume, as well as long life and freedom from vibration, are dependent on good fits, components are machined on the Warner & Swaseys to tolerances as low as .0005". Formerly Eco had to rough out pump bodies on turret lathes—then finish to the necessary close tolerances on specialized precision finishing equipment. Now all operations are handled easily on the 2ACs—and at production rates from 3 to 10 times faster than previous methods.

Our Field Engineers have the complete facts on how these versatile Automatic Chuckers can boost your production and profits on precision work. Why not call him in, today.

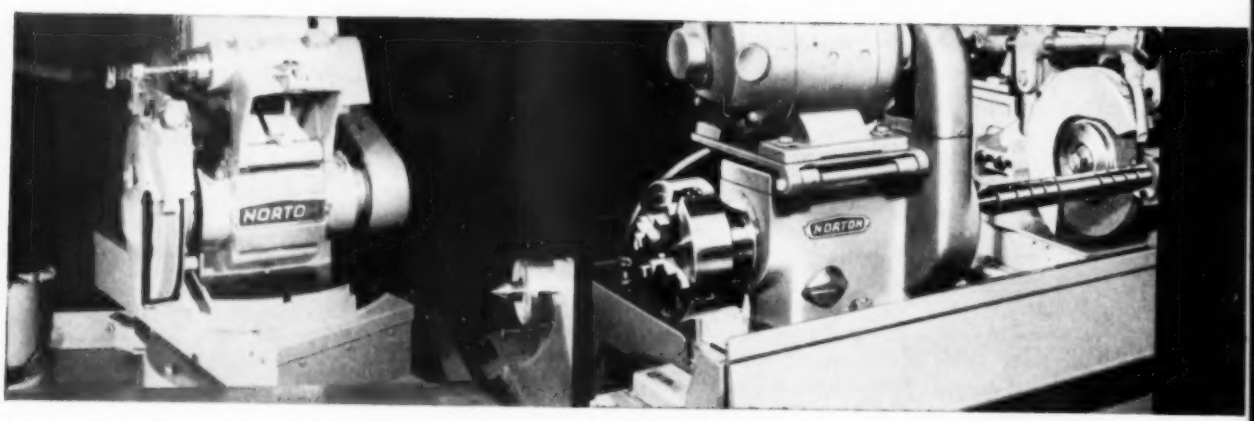


WARNER & SWASEY
Cleveland
PRECISION MACHINERY SINCE 1880

YOU CAN PRODUCE IT BETTER, FASTER, FOR LESS...WITH A WARNER & SWASEY

With fast change-over features like these...

Norton Universal Grinders do more...save more



The flexible grinding wheel head swivels above and below the slideways, permitting independent angular settings of wheel and feed — giving you the widest job range.

You can change from dead center to chucking work with minimum effort. Chuck remains mounted at back end of headstock when grinding "on centers".

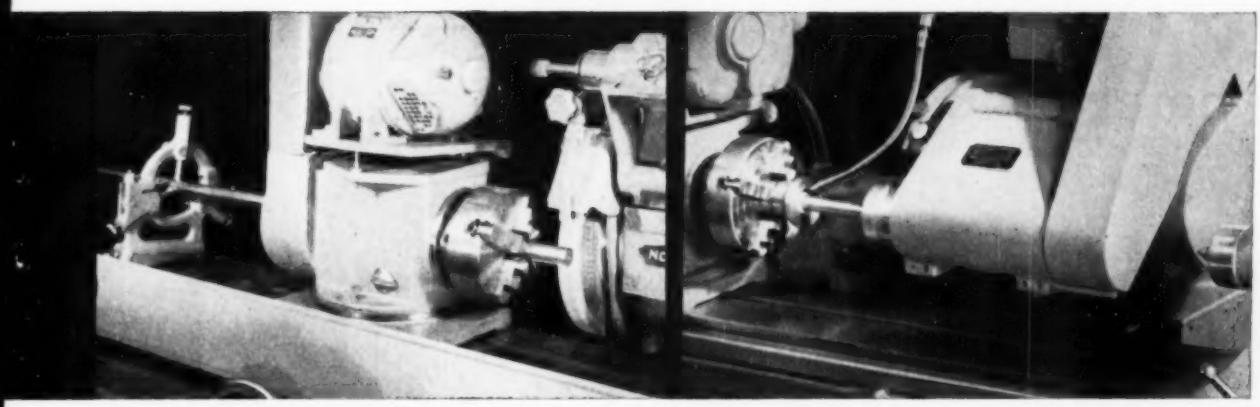
A Norton 12" Type U-4 Universal Grinder, available with 36" or 48" nominal lengths between centers, typical of Norton Universals.

Install any Norton Universal Grinder and you've got a practically complete grinding department — for faster external, internal, face, taper and angular wheelslide grinding, including many special jobs. That's because Norton builds exceptional versatility into all these famous universals, with time-and-money-saving "Touch of Gold" advantages like the following:

Extremely rapid chucking . . . quick change-over to live or dead spindle operation . . . wide range of easily changed work speeds . . . independent wheel and feed settings for doing difficult jobs fast . . . extra capacities in wheel head and headstock . . . precise swivel table alignment with the SWIVALIGN* *Dual Electric Indicator and semiautomatic plunge feed arrangement optional extras.*

Engineered for long service life in handling so many different jobs, Norton Universal Grinders are easy to operate and maintain. Their swing capacities range from 10" to 18". Your Norton Sales Engineer, a trained expert in the grinding field, will be glad to help you select the size you need — and to give you an accurate estimate of what this grinder can do for you. NORTON COMPANY, Machine Division, Worcester 6, Mass. District Offices: Worcester, Hartford, Cleveland, Chicago, Detroit. *In Canada:* J. H. Ryder Machinery Co., Ltd., Toronto 5.

*Trade-Mark Reg. U.S. Pat. Off. and Foreign Countries



Hollow headstock spindle gives you additional capacity for grinding long bars by passing them clear through and supporting them in grinding position.

Hinged-bracket type internal grinding spindle swings up and out of the way when not in use. This means quicker set-ups for your I.D. or O.D. grinding.

NORTON
GRINDERS and LAPPERS
Making better products
...to make your products better

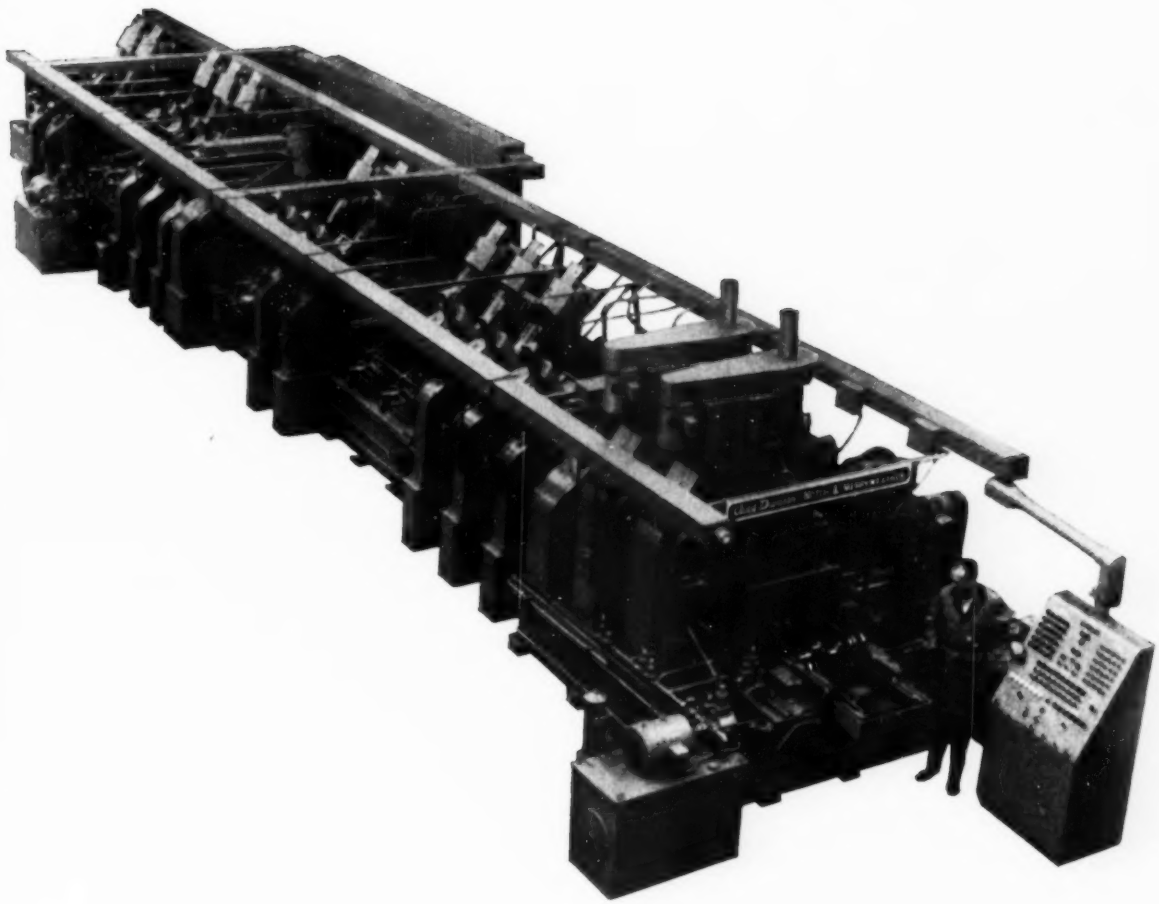
NORTON PRODUCTS Abrasives • Grinding Wheels • Grinding Machines • Refractories • Electrochemicals — BEHR-MANNING DIVISION Coated Abrasives • Sharpening Stones • Pressure-Sensitive Tapes

"My order board is full.
My customers are crying for deliveries.
My dealers are pleading for quotes.
I could be making money
if I'd had the guts to tool up
before the rush."

▶ It's happened before, and it will happen again. Your investment now in Avey equipment will put you ahead of your competition when the '60's come booming along.
Avey Division, The Motch & Merryweather Machinery Co., Box 1264, Cincinnati 1, Ohio

drilling, tapping, production machines

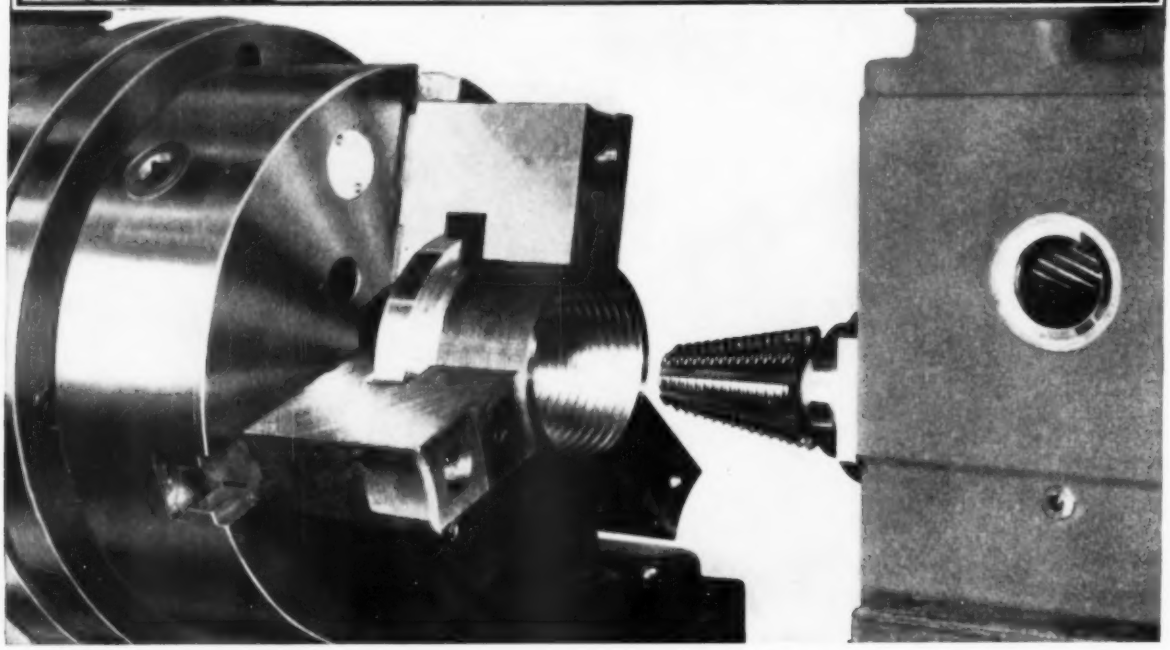
Avey



▶ Modular Avey machine performs the following operations on 60 crankshafts per hour at 100% efficiency: drills all angular oil holes plus connecting metering holes; drills, chamfers, and taps all flange holes. The machine includes standard Aveydraulic Torquematic units for deep hole drilling, cam feed units, and Hydroway slides and lead screw tapping units. The indexing mechanism is hydraulically operated. Chips are carried away by a link belt conveyor. Hydraulics and electrics conform to J.I.C. standards. Standard Avey units can be re-grouped to handle later design changes.

SUNDSTRAND

"ENGINEERED PRODUCTION" NEWS



Thread Milling Added to Sundstrand Service

Further expansion of the Sundstrand Machine Tool Company's service is announced with the addition of Hanson-Whitney thread milling machines. Four standard sizes of machines are included in the line with specially fixtured or adapted machines available for unusual threading requirements.

The Hanson-Whitney method of thread milling uses multiple-thread milling cutters and can be used to generate internal or external, right or left hand, straight or taper, standard or special threads on a wide variety of parts. Precision cams control the whole process automatically, the operator only has to load and unload. Workpieces can be held on centers, in standard chucks, or in special fixtures. Simplicity of setups permits them to be handled in minimum time.

Application of Sundstrand "Engineered Production" to this thoroughly proved line of thread milling machines opens new opportunities for production improvements and cost reductions. Sundstrand's experience in every type of manufacturing job, coupled with unmatched skills in machine and fixture design, has solved thousands of milling, turning, broaching, grinding, and special machine problems. These same skills and experience now being applied to thread milling are sure to provide similar user benefits wherever the process is applied.

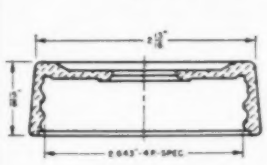
Advantages of H-W Thread Milling

- Produces thread pitches too coarse for practical die cutting.
- Speed and efficiency improved over single point cutting in a lathe, disc-type cutters in a conventional thread miller, or single wheel grinding.
- Threads produced are smoother and more accurate than those obtained with tap or die.
- Pitch diameter of threads bears definite and accurate relationship to other workpiece elements.
- Permits automatic convolution of the first thread.
- Threads can be produced in locations impossible or impractical through use of lathe, tap or dies.
- Close tolerances are readily maintained on repetitive parts.
- Scrap losses are held to a minimum even on high speed, close tolerance work.
- Semi-automatic operation permits one operator to handle several machines.

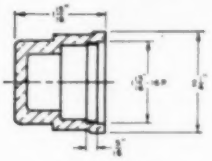
AUTOMATIC LATHES | RIGIDMILS | SPECIAL MACHINES | DRILLING MACHINES | GRINDERS

SUNDSTRAND

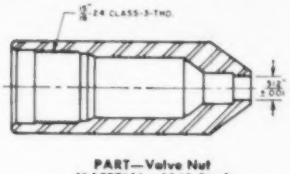
Typical parts thread milled on H-W machines



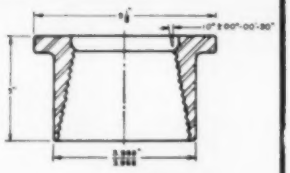
PART—Container End
MATERIAL—Die Cast
THREAD—4-Pitch Special Form
MACHINE TIME—17 seconds



PART—Fuse Part
MATERIAL—Aluminum
THREAD—1-13/16-16, N. S. 3 THD.
MACHINE TIME—15 seconds



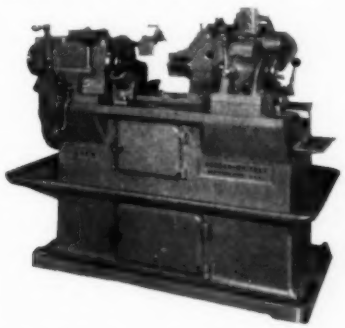
PART—Valve Nut
MATERIAL—1141 Steel
(Rockwell "C" 26-32)
THREAD—15/16—24, N. S. 3 THD.
MACHINE TIME—38 seconds



PART—Ferrule
MATERIAL—4340 steel
(Rockwell "C" 28-32)
THREAD—5 Pitch Special Taper

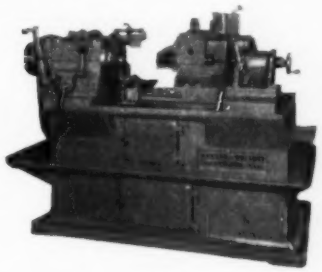
4 x 9 inch semi-automatic (hydraulic)

Smallest size of machine in the Hanson-Whitney line has an external capacity of 4″ diameter with a 2″ cutter and an internal capacity of either 4″ diameter with a 2″ cutter, or a 3/4″ minimum diameter with 1/2″ cutter. Collet to tailstock center distance is 12″ and thread can be cut up to 9″ from collet. Maximum lead for either hand of internal or external thread is 1/5″. Machine occupies a floor space of 43″ x 68″.



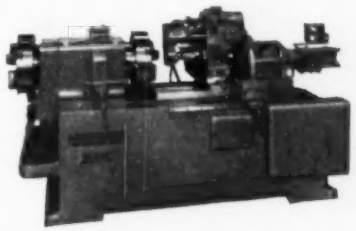
8 x 16 inch semi-automatic

Distance from collet to tailstock center is 27″. Thread can be cut for a distance of 16″ from collet. External thread capacity is up to 8″ diameter with a 2-1/2″ cutter, internal thread maximum capacity is 8″ with a 2-1/2″ cutter and 1″ minimum diameter with a 7/16″ cutter. Machine is supplied with drawback collet mechanism, with master collet 2″ or 3″, cutter head with arbor and arbor support for cutters 3-1/2″ long, one lead cam for any pitch specified, coolant equipment and complete electrical equipment as standard equipment.



10 x 24 inch semi-automatic

External thread capacity is up to 10″ diameter with 2-1/2″ cutter and internal thread capacity ranges from 10″ diameter maximum with a 2-1/2″ cutter to 1″ diameter minimum, with a 7/16″ cutter. Standard machine equipment includes drawback collet mechanism with master collet 2-1/2″ or 4″, cutter head with arbor and arbor support for cutters 3-1/2″ long, one lead cam for any pitch specified, complete coolant system, and complete electrical system. Oversize workheads are available permitting up to 22″ swing over carriage and use of a 5″ master collet.



15 x 30 inch semi-automatic

External and internal capacity of the largest standard Hanson-Whitney machine is up to 15″ diameter with thread cut to 30″ from the collet. Swing over the carriage is 21″. Maximum lead for either right or left hand thread is 5/8″. Standard machine includes cutter head with arbor support, one lead cam for any pitch specified, coolant equipment, and complete electrical equipment. Like all standard machines in the line, it can be furnished with special cams to extend the range of cam throws.

To keep costs low while meeting special job requirements semi-standard machines can be developed which make maximum use of standard components, such as special cutter heads and supports, long beds, special work holding devices, and automatic loaders.

Get more thread milling data from Sundstrand. Write for Bulletin 101 today.

BROACHING TOOLS BROACHING MACHINES PRESSES

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ARMSTRONG

TOOL HOLDERS

A Correct Tool for Every Lathe Operation

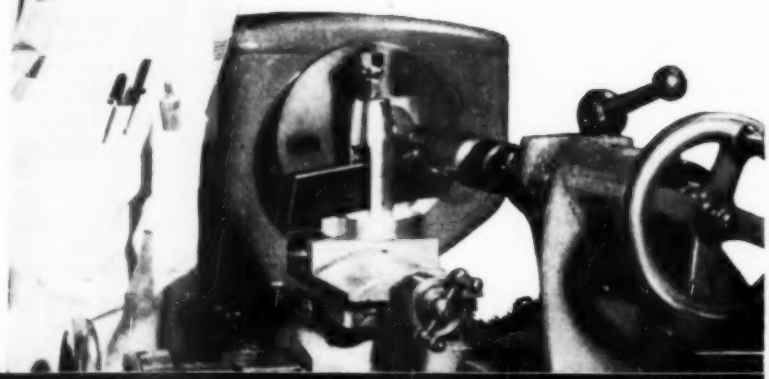
You can save time (and money) by ensuring that your machine tools are equipped with *adequate numbers* of the correct ARMSTRONG Tool Holders. The ARMSTRONG System of Tool Holders includes correctly designed tools for *every* standard operation on lathes, shapers, and planers, and for many operations on turret lathes and screw machines. By utilizing the ARMSTRONG System of Tool Holders, you can reduce tooling costs, eliminate down time in tooling up, operate your machine tools at maximum feeds and speeds.

ARMSTRONG Tool Holders are long-lasting tools. They are strong beyond need, handy and efficient, profitable to use, and are readily available from your local ARMSTRONG Distributor.

Check over your ARMSTRONG Tool Holder needs.
Write for literature.

INDUSTRIAL DISTRIBUTORS · THE RIGHT HAND OF PRODUCTION

If you do not know the name of your local ARMSTRONG Distributor, inquire when asking for literature.

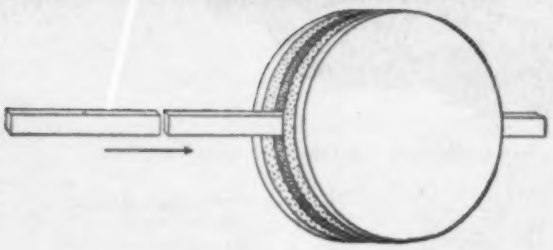


ARMSTRONG BROS. TOOL CO. 5215 W. ARMSTRONG AVE. CHICAGO 46, ILL.

Disc grinder finishes two parallel surfaces in one operation

... Gardner grinder with feed thru work fixture
- gives continuous high production
- assures lowest unit grinding cost
- grinds to precision tolerances

Gardner 2H30 precision double spindle grinder with feed thru fixturing



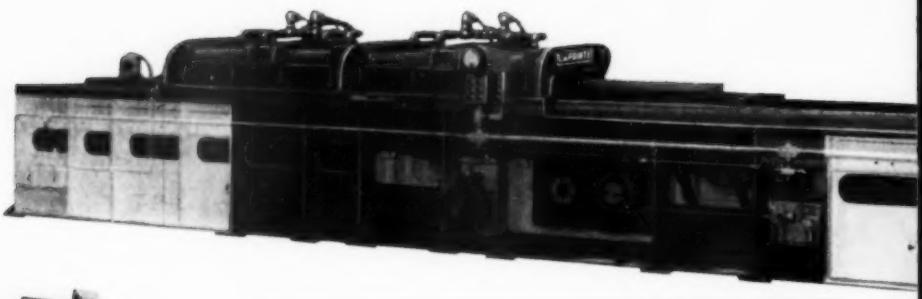
Feed thru double disc grinding

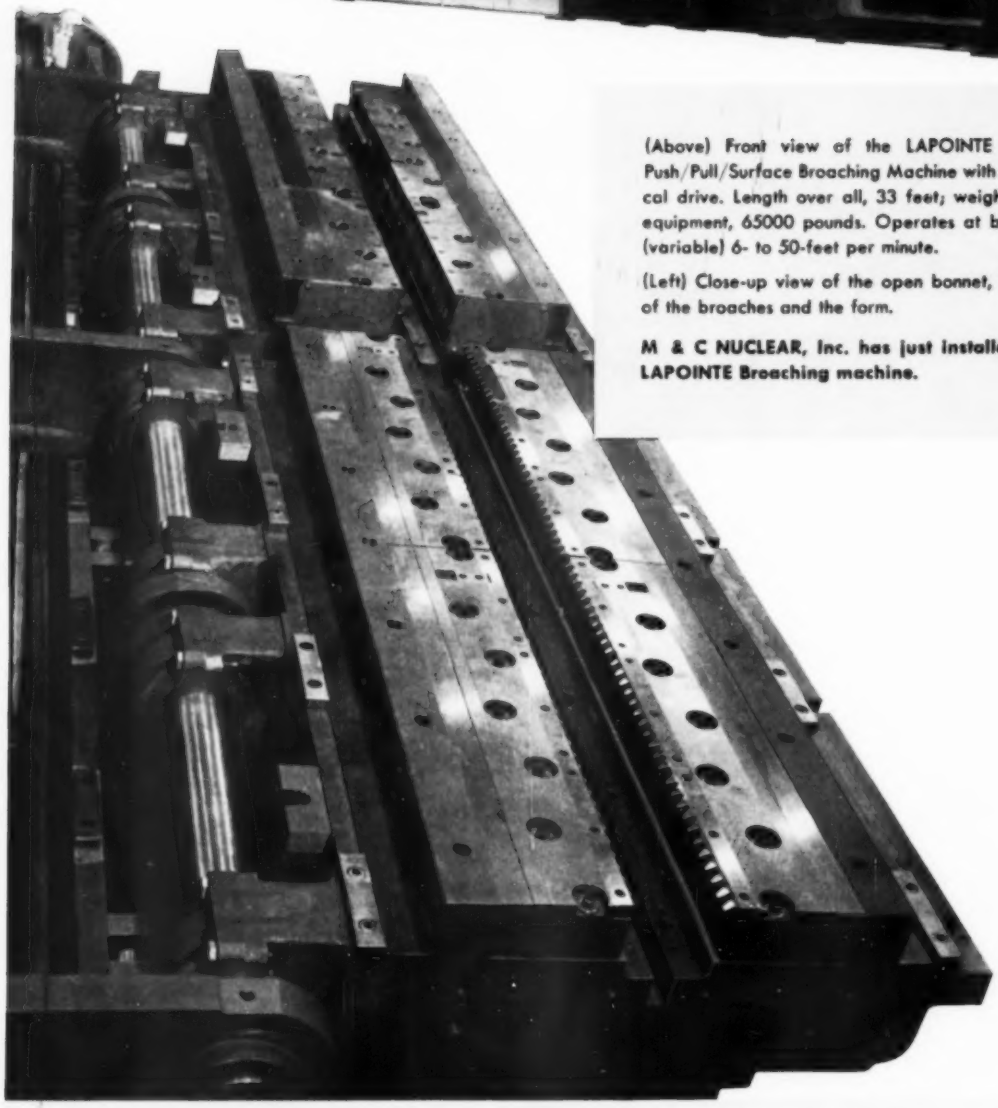
Typical parts: ..... bearing races, covers, plates, runner bars
Production: ..... 2000 to 6000 parts per hour
Stock removal: ..... .010" to .020"
Flatness: ..... .0001" to .0006"
Parallelism: ..... .0001" to .0007"
Uniformity: ..... .0008" to .001"

GARDNER

precision disc grinders

BELOIT, WISCONSIN



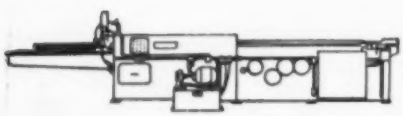


(Above) Front view of the LAPOINTE 180-inch stroke Push/Pull/Surface Broaching Machine with electro-mechanical drive. Length over all, 33 feet; weight, with electrical equipment, 65000 pounds. Operates at broaching speeds (variable) 6- to 50-feet per minute.

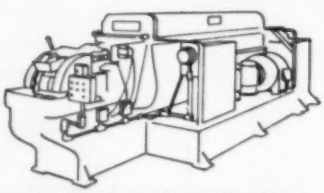
(Left) Close-up view of the open bonnet, showing the size of the broaches and the form.

M & C NUCLEAR, Inc. has just installed this modern LAPOINTE Broaching machine.

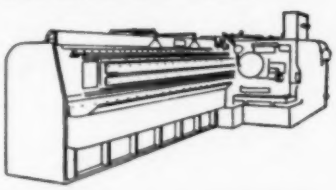
Lapointe-built Broaching Machines are available in hydraulic and electro-mechanical drives.



60" STROKE HORIZONTAL, ELECTRIC

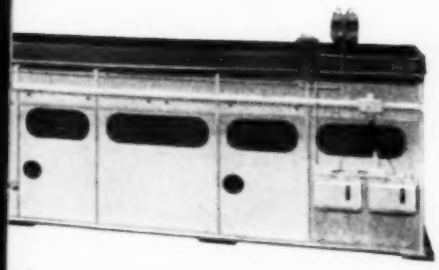


CH CONTINUOUS BROACHING, ELECTRIC



SRHE SINGLE RAM HORIZONTAL, ELECTRIC

URANIUM · TITANIUM · ZIRCALLOY · 347 STAINLESS



Are you puzzled about BROACHING the materials of this atomic age?

If so, let LAPOINTE —BROACHING solve your problems . . . now!

No one can equal Lapointe's experience in broaching the difficult metals used in today's jets, missiles and nuclear power plants. As far back as 1950, we were broaching test specimens of zirconium — and our research and experimentation have kept abreast of all the metals and alloys in this critical field.

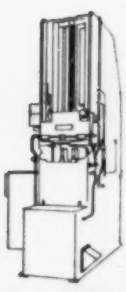
The Lapointe machine shown here is broaching a part in zircalloy, constituting one of the very latest developments of our fast-moving atomic age. Tolerances are close, the part is thin, *and five feet long!* Nevertheless, production is amazingly fast — about 100-to-1 against another metal-removing method that was being used.

Lapointe has been recognized as the undisputed leader in the art of broaching, with nearly sixty years of engineering experience to draw on, *exclusively in broaching.* All of this valuable background is available to you, to solve your most difficult metal-working problems. A request will bring a qualified Lapointe Field Engineer to your plant, promptly.

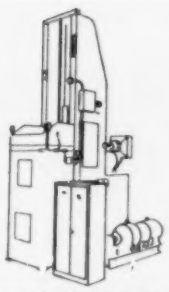
THE LAPOINTE MACHINE TOOL COMPANY

HUDSON, MASSACHUSETTS • U.S.A. *In England: Watford, Hertfordshire*

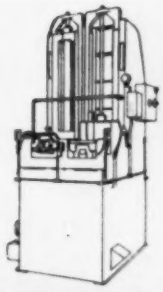
THE WORLD'S OLDEST AND LARGEST MANUFACTURERS OF BROACHING MACHINES AND BROACHES



VUE-7 VERTICAL PULL-UP ELECTRIC



SRVE SINGLE RAM VERTICAL, ELECTRIC



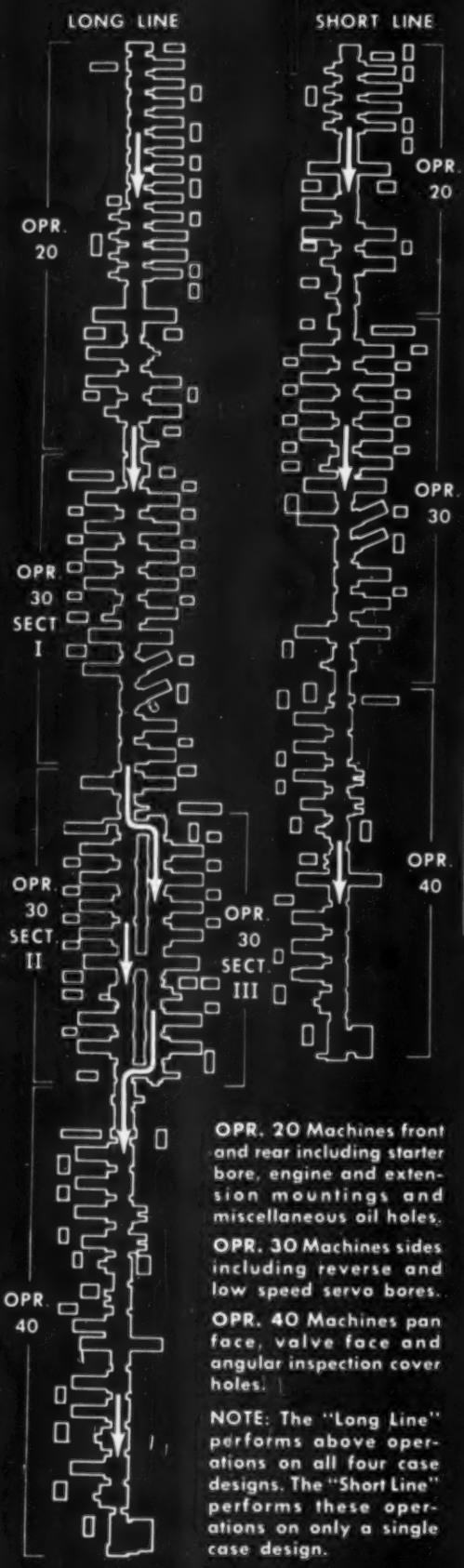
DRVE DOUBLE RAM VERTICAL, ELECTRIC

LAPOINTE

known to be the best in

BROACHING

Complete Product Mix Processed On New Cross Transfer-matics



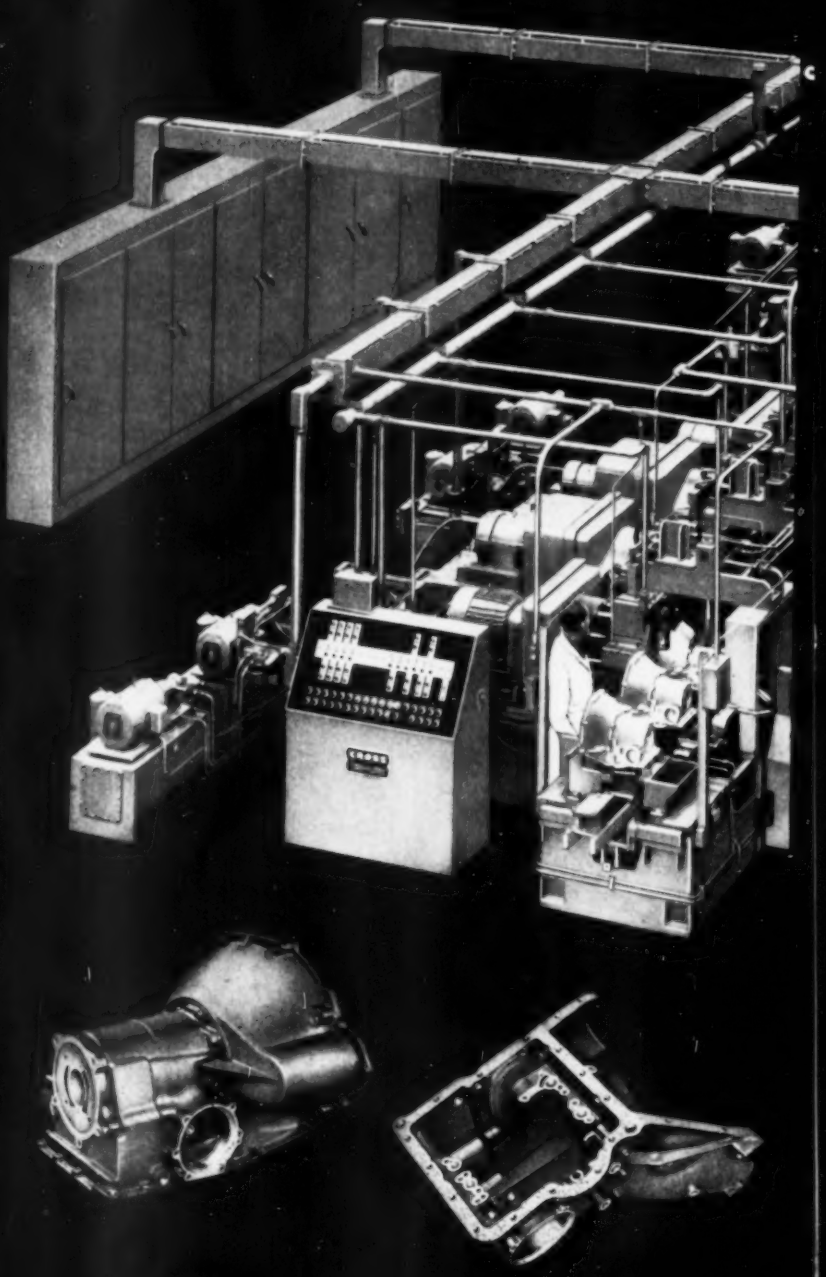
OPR. 20 Machines front and rear including starter bore, engine and extension mountings and miscellaneous oil holes.

OPR. 30 Machines sides including reverse and low speed servo bores.

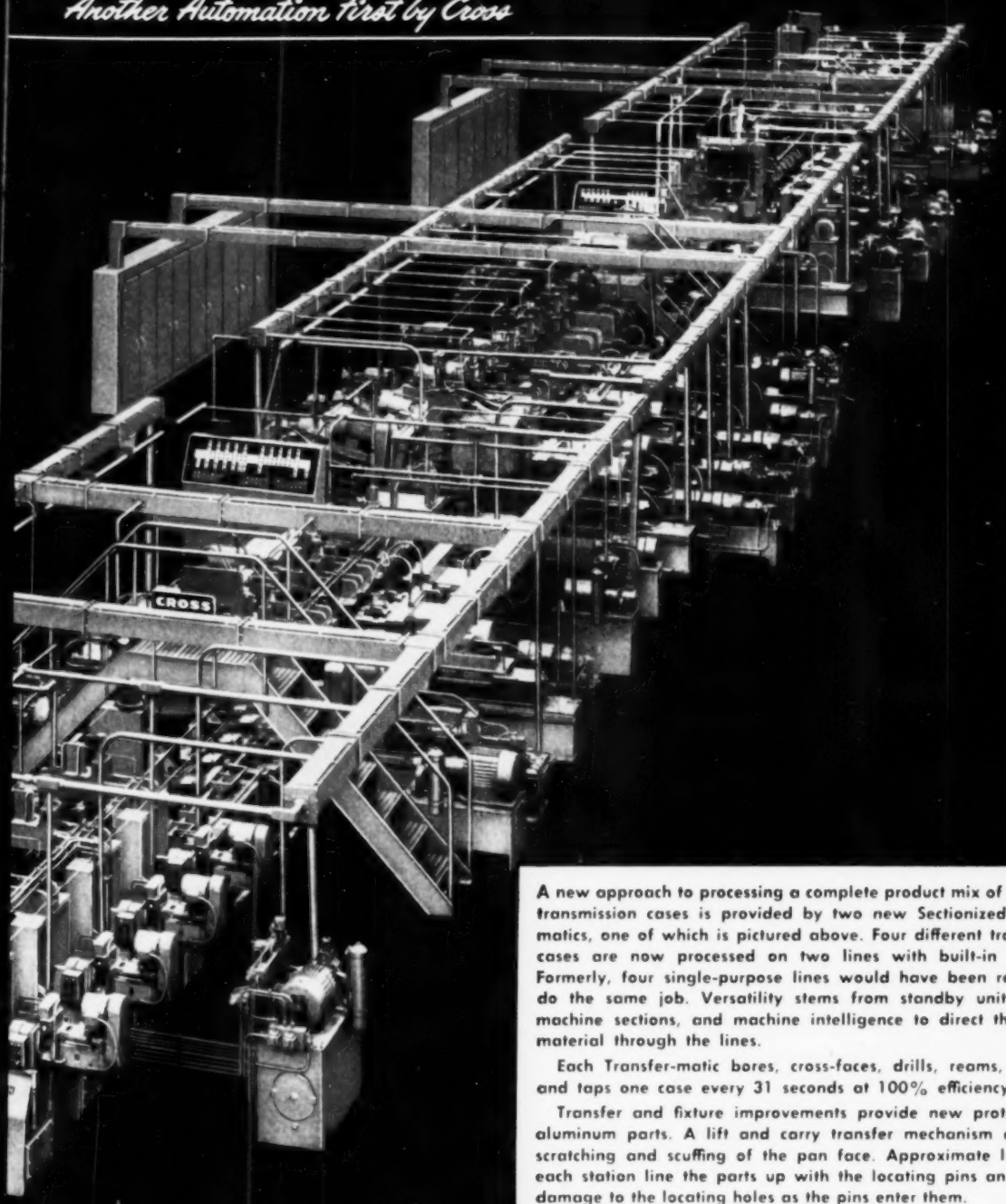
OPR. 40 Machines pan face, valve face and angular inspection cover holes.

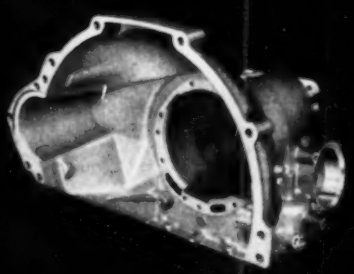
NOTE: The "Long Line" performs above operations on all four case designs. The "Short Line" performs these operations on only a single case design.

Floor Plan Layout of Two New Cross Sectionized Transfer-matics



Another Automation First by Cross





A new approach to processing a complete product mix of aluminum transmission cases is provided by two new Sectionized Transfer-matics, one of which is pictured above. Four different transmission cases are now processed on two lines with built-in flexibility. Formerly, four single-purpose lines would have been required to do the same job. Versatility stems from standby units, off-line machine sections, and machine intelligence to direct the flow of material through the lines.

Each Transfer-matic bores, cross-faces, drills, reams, chamfers and taps one case every 31 seconds at 100% efficiency.

Transfer and fixture improvements provide new protection for aluminum parts. A lift and carry transfer mechanism eliminates scratching and scuffing of the pan face. Approximate locators in each station line the parts up with the locating pins and prevent damage to the locating holes as the pins enter them.

Down time is minimized by use of "static" controls since conventional relay maintenance is virtually eliminated. Programmed tool changes with Cross Toolometers and Machine Control Units and a machine communications network facilitate "combined" tool and machine maintenance.

Sectionized machine design insures peak output by feeding parts into the machine behind "down sections."

The Cross "building block" principle and optimum standardization assure highest flexibility for part design changes or re-application of machine units for entirely new part processing.

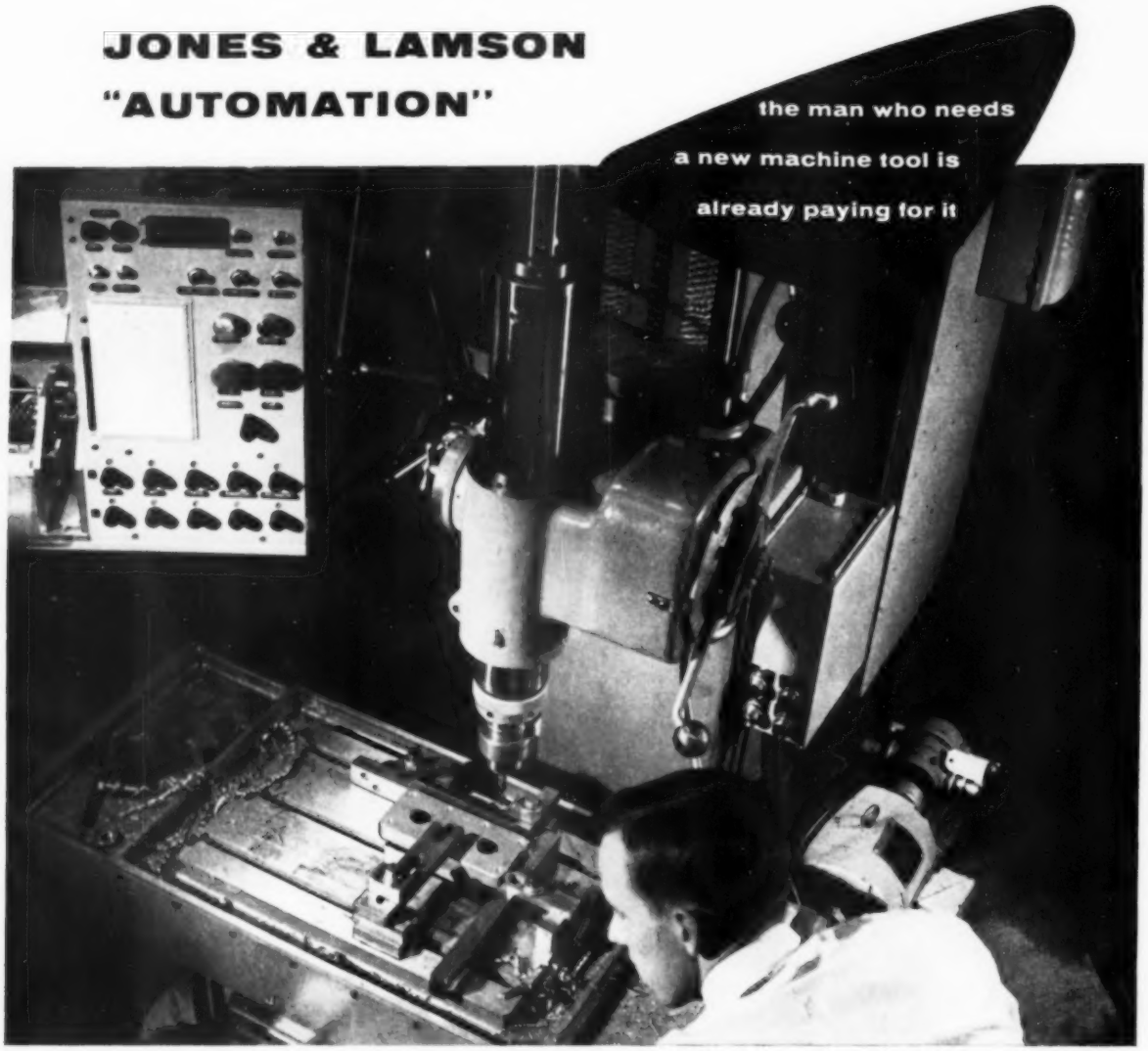
Established 1898

THE **CROSS** CO.

First in Automation

PARK GROVE STATION • DETROIT 5, MICHIGAN

JONES & LAMSON "AUTOMATION"



Numerical control positioning eliminates jigs – saves time

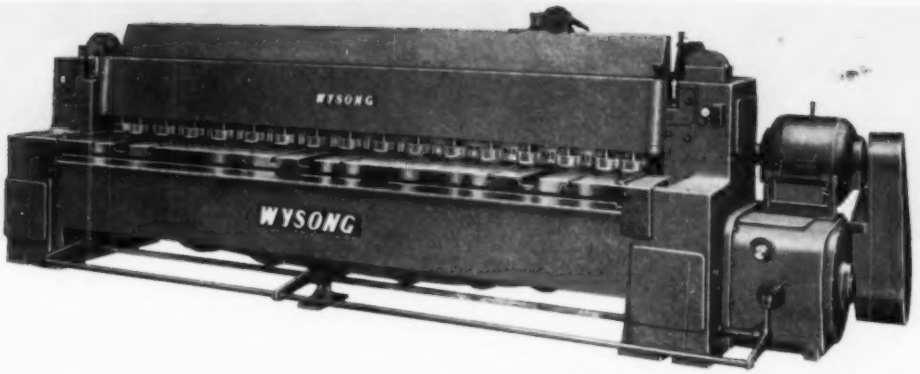
The J&L Numerically Controlled Positioning Table quickly and accurately positions work pieces to an accuracy of ±.001" — without jigs. And it can do it economically with any lot size down to a single piece.

For instance: in one installation, where precision parts previously had been machined on a conventional spacing table, J&L's new equipment achieved cycle time savings of six minutes per piece and set-up savings of over 116 minutes per set-up, or a total savings of 6.95 hours on a lot of 50 pieces.

In another plant, the cost of building $4,000 worth of jigs was eliminated during the first six weeks of operation. And in still another operation, the positioning table not only reduced set-up and cycle time, but also eliminated the storing, handling and maintenance of $29,000 worth of jigs.

You can get in on this kind of savings too. Write to Jones & Lamson Machine Company, 502 Clinton Street, Springfield, Vermont.

Turret Lathes • Fay Automatic Lathes • Milling & Centering Machines • Thread & Form Grinders • Optical Comparators • Thread Tools



MODEL 1225 — Capacity 12' x ¼" Other models from 24" through 12' cutting lengths and 16 ga. through ½" capacities.

THE SHEAR

THEY DIDN'T REMEMBER

It was a big company with a new Purchasing Agent. He didn't remember a shear bought two years ago. He did find a record of its purchase but no report on its performance.

The Production Manager recalled its installation but he didn't have a record of performance either. So he got the Foreman of the Fabricating Department on the phone.

"Joe, you have squawked about troubles you have had with some of your shears and I have your reports on them. But, I don't have any report on that Wysong shear we installed a couple of years ago. How come?"

"Well, boss, what's there to report? The only time it's been down was when we changed blade edges. It has automatic lubrication so there is practically no maintenance. It's working every day and gives us the accuracy we want — the production, too. There is nothing to report!"

When you install a Wysong don't expect a lot of reports on it — just unsurpassed accuracy, minimum down time and maximum production. That is why so many users say:

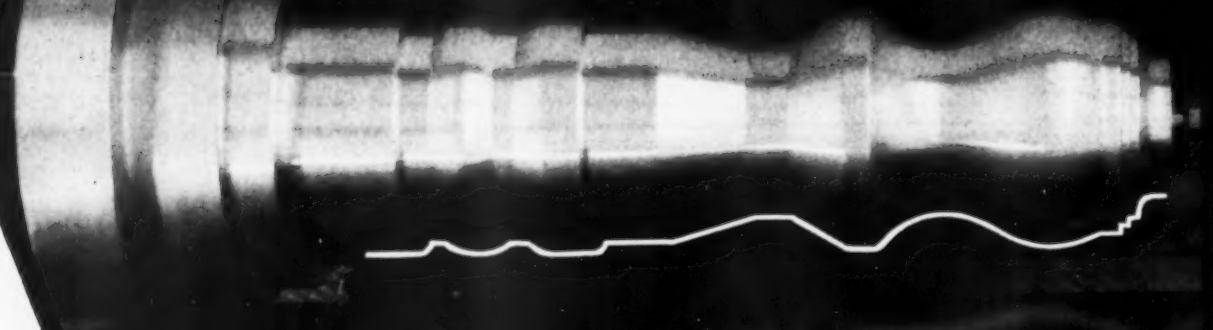
"Buy a WYSONG — it's MILES ahead"

Based on experience of Wysong service man making a routine check.

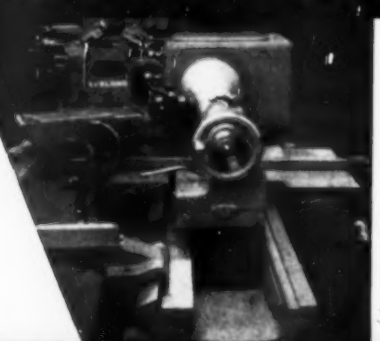
WYSONG

WYSONG & MILES COMPANY
635 Fulton Street
GREENSBORO, N. C.

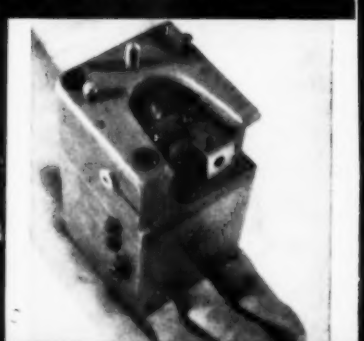
New Tracer? Yes!



SIMPLICITY ITSELF! All parts mount on lathe, need no extra floor space. Set-up takes less than 15 minutes. Short hoses are located out of operator's way.



LOCKED-CIRCUIT VALVE is secret of responsive operation. Precision plunger hits to .0001". Valve maintains constant accuracy, does not heat up in operation.



All new* from LeBlond

REGAL-TRACE

**New principle, new design, new convenience, new price—as low as $2760!*

Now, a completely new tracer unit designed exclusively for famous LeBlond Regals and Dual Drives. Regal-Trace! Engineered from the start for convenience, compactness, responsiveness, precision and economy. LeBlond quality throughout – and new low prices beginning at $2760 (for 13" Regal model).

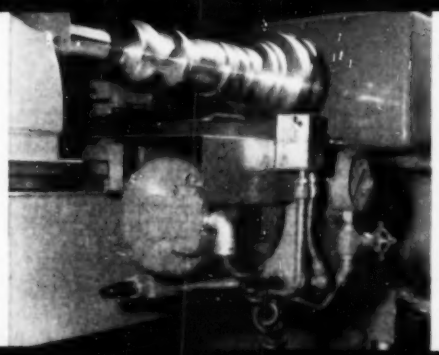
Easy to use – Traces radii, stepped shafts, contour faces, tapers, compound and spherical curves. Swivels 45° either side of perpendicular to the work. Cuts toward or away from headstock. Uses easily prepared flat templates.

Self-Contained – Only 4 major parts: tracer unit, power unit, template carrier and bed bracket assembly. All parts, including compact hydraulic system mount on lathe. No extra floor space required. Tracer unit replaces compound rest, can be installed and operating (or removed) in less than 15 minutes. No reduction whatever in swing capacity. Permanently rear-mounted hydraulic unit becomes integral part of machine, does not interfere with normal lathe operation.

Accurate, smooth, fast – Locked-circuit hydraulic system delivers a new degree or responsiveness and precision. Stylus pressure less than one pound. Will consistently reproduce parts to accuracy of ± .0005". Pressure is maintained at 300 psi (or higher if desired). Hydraulic cylinder provides feed rate of 75 in. per minute. Unique valve unit is preset at factory, requires no adjustment.

Fits any LeBlond Regal built since 1955 and all Dual Drives. Can be installed in the field or purchased as original equipment on new lathes. Write today for complete information and specifications on the all-new LeBlond Regal-Trace or see your LeBlond Distributor.

COMPACT HYDRAULIC UNIT mounts permanently at rear, does not interfere with normal lathe operation. Includes oil reservoir, pump, motor, relief valve.



EASILY PREPARED flat templates mount conveniently at front of lathe, are easily stored between jobs. Straight template or straight edge used for turning tapers.

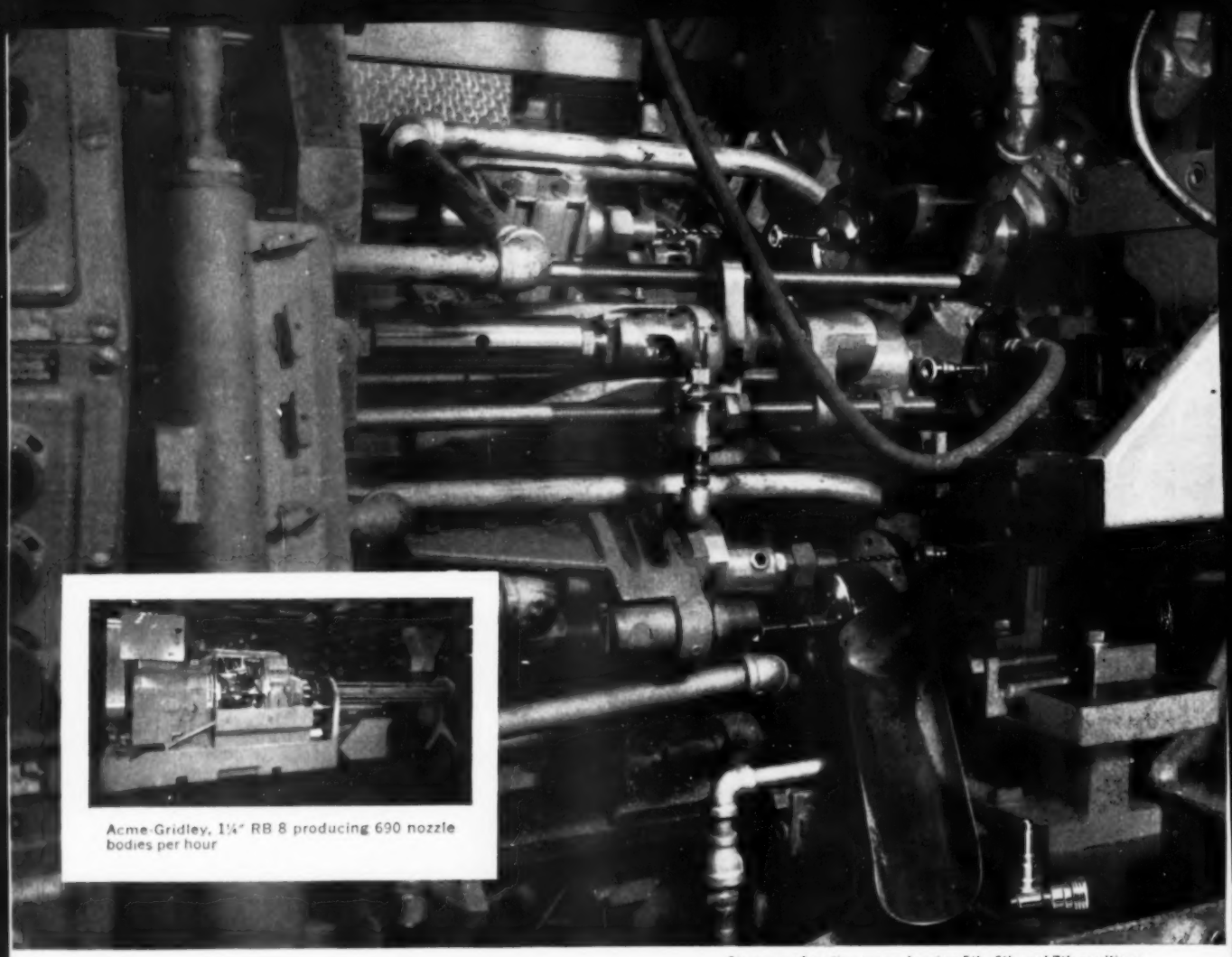
LeBLOND of Cincinnati

...cut with confidence

The R. K. LeBlond Machine Tool Co.

Cincinnati 8, Ohio

World's Largest Builder of a Complete Line of Lathes for More Than 72 Years



Acme-Gridley, 1¼" RB 8 producing 690 nozzle bodies per hour

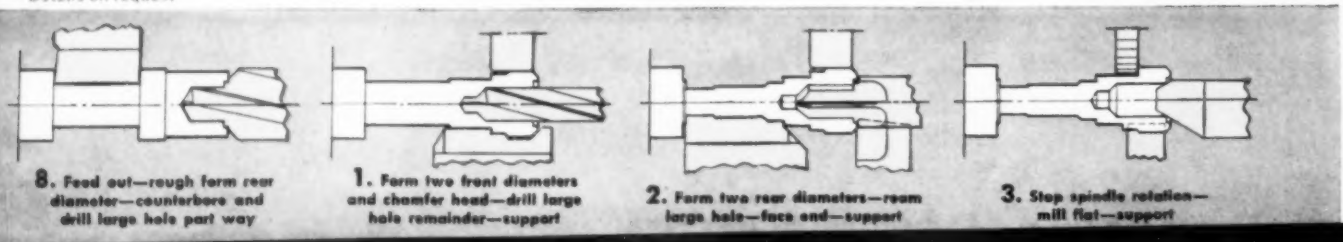
Close-up of tooling zone showing 5th, 6th and 7th positions.

ACME-GRIDLEY ELIMINATES SECONDARY OPERATIONS...

for Eagle Manufacturing Company

- Direct Cost Reduced 48%*
- Production Time Reduced 64%

* Details on request



8. Feed out—rough form rear diameter—counterbore and drill large hole part way

1. Form two front diameters and chamfer head—drill large hole remainder—support

2. Form two rear diameters—ream large hole—face end—support

3. Stop spindle rotation—mill flat—support

As a part of a continuing contribution to all phases of cost reduction, National Acme engineers initiated the development work necessary to effect important savings for this 65 year old Wellsburg, W. Virginia company.

The aluminum nozzle body of their hydraulic pump oilers formerly had been produced on a six spindle automatic and two other machines performing secondary operations. Visionary machine tool engineering made possible the application of spindle stopping and positioning on an eight-spindle Acme-Gridley to complete the entire piece *in the primary set-up . . . and increase net production.*

Advanced design and development such as this, together with wide open tooling zones, independently operated tool slides and the extreme accuracy and flexibility of direct camming . . . makes possible the solution of "unusual" jobs an "every day" occurrence at National Acme.

Write or ask one of our representatives for the complete story on the industry's most modern approach to *your* cost reduction problem.

NATIONAL ACME'S
"ZONE OF RESPONSIBILITY"
INCLUDES ALL PHASES OF COST REDUCTION

Check YOURS . . . Then Check National Acme

Direct Costs: these include direct dollar savings as realized by the Eagle Manufacturing Company . . . an "every day" job for Acme-Gridleys.

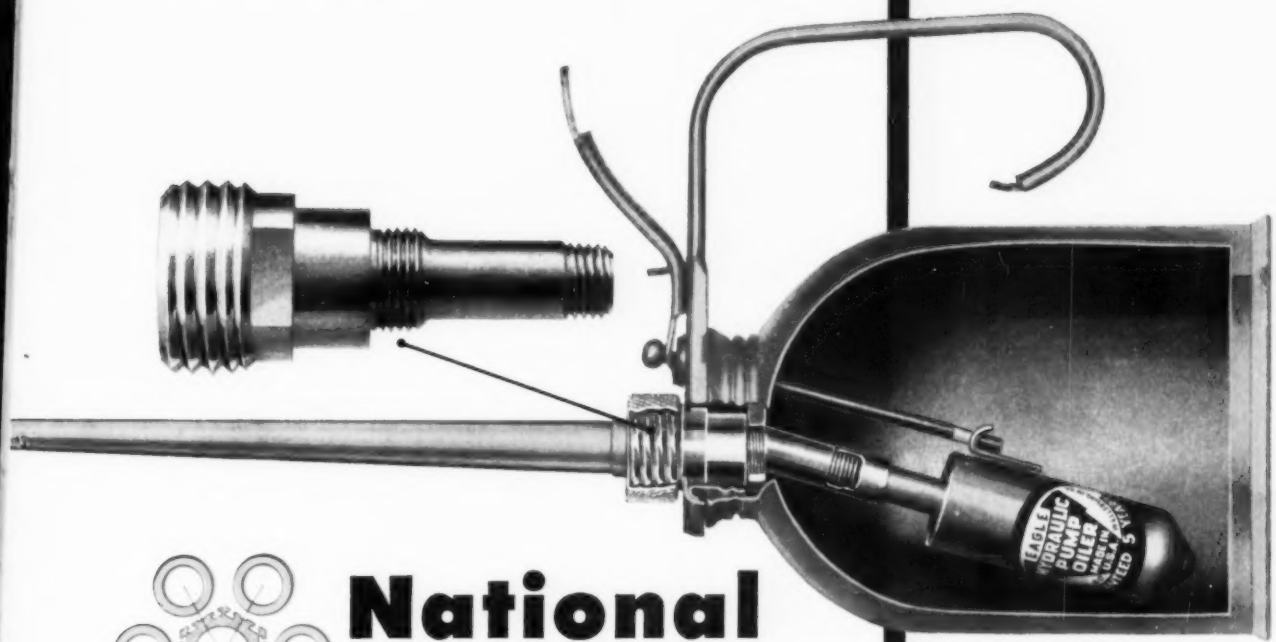
Indirect Costs: effecting important savings in maintenance, downtime, scrap reduction, tool costs, etc.

Product Redesign: teaming with your design group to take full advantage of Acme-Gridleys' cost reducing capabilities.

Direct Material Costs: our engineers provide important savings in this area by constantly matching machines and tools to modern metallurgical problems.

Make-or-Buy Reviews: in many cases our Contract Division can assume your production headaches and relieve you of immediate capital investment.

Spot Modernization: pioneering in modern tooling methods, and the flexibility of Acme-Gridleys can provide many "on-the-spot" savings.



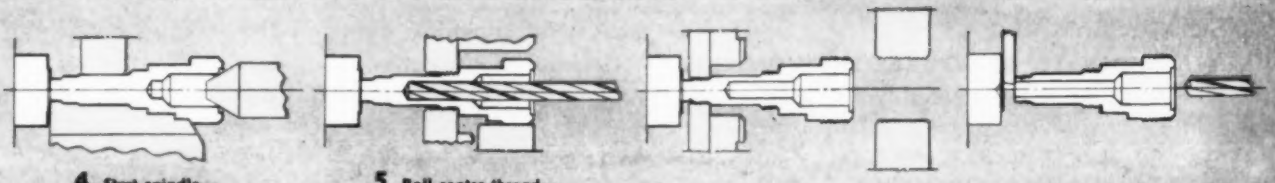
Pioneer in Circumferential Automation

National Acme

The National Acme Company
171 E. 131st Street
Cleveland 8, Ohio

Sales Offices: Newark 2, N.J.; Chicago 6, Ill.; Detroit 27, Mich.

15 Operations in 5.5 Seconds

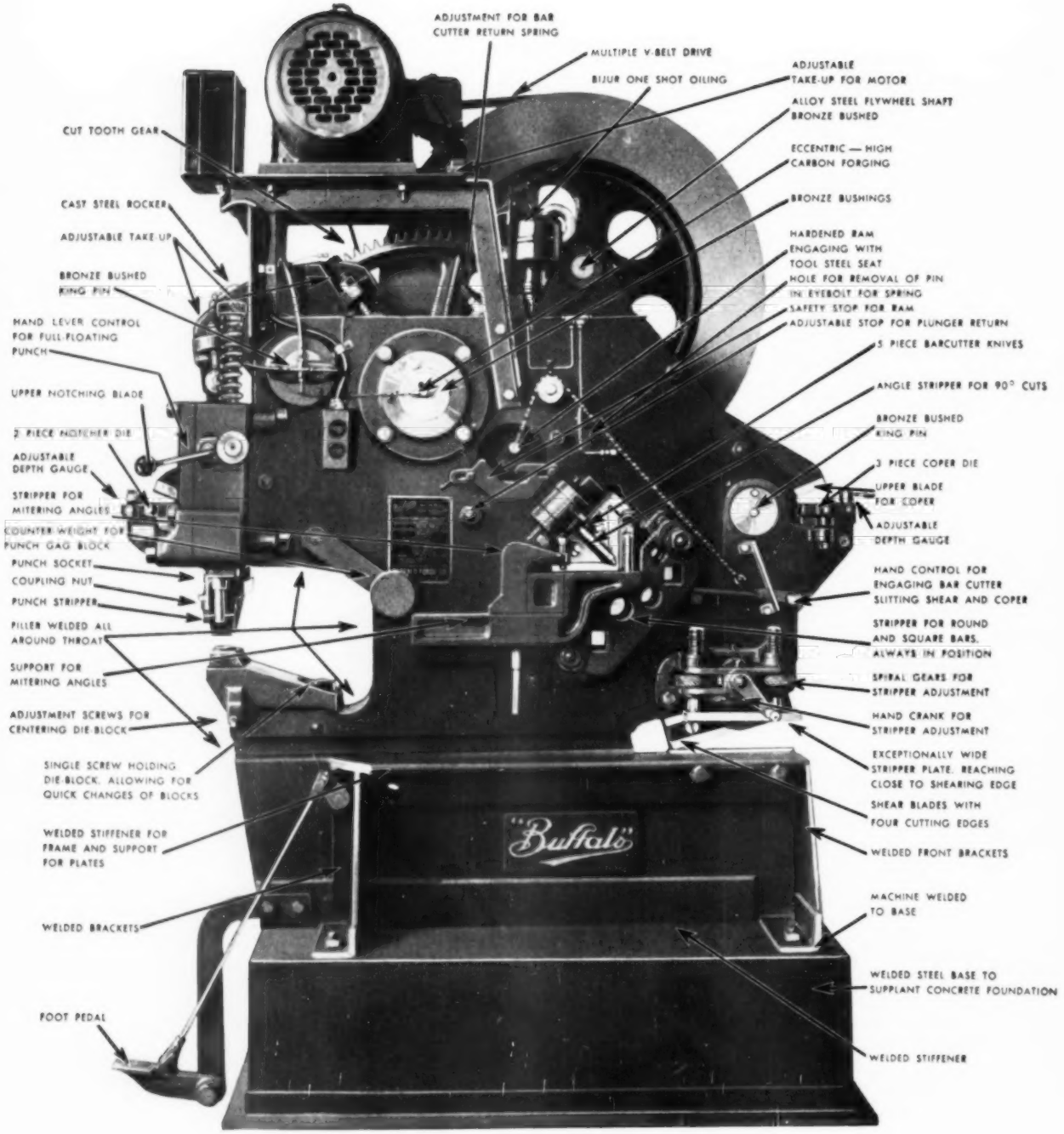


4. Start spindle—shave all over—support

5. Roll center thread—drill small hole part way—support

6. Roll rear thread—thread head

7. Drill small hole remainder—cutoff


ADJUSTMENT FOR BAR CUTTER RETURN SPRING
MULTIPLE V-BELT DRIVE
BIJUR ONE SHOT OILING
ADJUSTABLE TAKE-UP FOR MOTOR
ALLOY STEEL FLYWHEEL SHAFT BRONZE BUSHED
CUT TOOTH GEAR
ECCENTRIC — HIGH CARBON FORGING
CAST STEEL ROCKER
BRONZE BUSHINGS
ADJUSTABLE TAKE-UP
HARDENED RAM ENGAGING WITH TOOL STEEL SEAT
BRONZE BUSHED KING PIN
HOLE FOR REMOVAL OF PIN IN EYEBOLT FOR SPRING
SAFETY STOP FOR RAM
HAND LEVER CONTROL FOR FULL-FLOATING PUNCH
ADJUSTABLE STOP FOR PLUNGER RETURN
5 PIECE BARCUTTER KNIVES
UPPER NOTCHING BLADE
ANGLE STRIPPER FOR 90° CUTS
2 PIECE NOTCHER DIE
BRONZE BUSHED KING PIN
ADJUSTABLE DEPTH GAUGE
3 PIECE COPER DIE
STRIPPER FOR MITERING ANGLES
UPPER BLADE FOR COPER
COUNTER WEIGHT FOR PUNCH GAG BLOCK
ADJUSTABLE DEPTH GAUGE
PUNCH SOCKET
HAND CONTROL FOR ENGAGING BAR CUTTER SLITTING SHEAR AND COPER
COUPLING NUT
PUNCH STRIPPER
STRIPPER FOR ROUND AND SQUARE BARS, ALWAYS IN POSITION
PILLER WELDED ALL AROUND THROAT
SUPPORT FOR MITERING ANGLES
SPIRAL GEARS FOR STRIPPER ADJUSTMENT
ADJUSTMENT SCREWS FOR CENTERING DIE BLOCK
HAND CRANK FOR STRIPPER ADJUSTMENT
EXCEPTIONALLY WIDE STRIPPER PLATE, REACHING CLOSE TO SHEARING EDGE
SINGLE SCREW HOLDING DIE-BLOCK, ALLOWING FOR QUICK CHANGES OF BLOCKS
SHEAR BLADES WITH FOUR CUTTING EDGES
"Buffalo"
WELDED STIFFENER FOR FRAME AND SUPPORT FOR PLATES
WELDED FRONT BRACKETS
MACHINE WELDED TO BASE
WELDED BRACKETS
WELDED STEEL BASE TO SUPPLANT CONCRETE FOUNDATION
FOOT PEDAL
WELDED STIFFENER

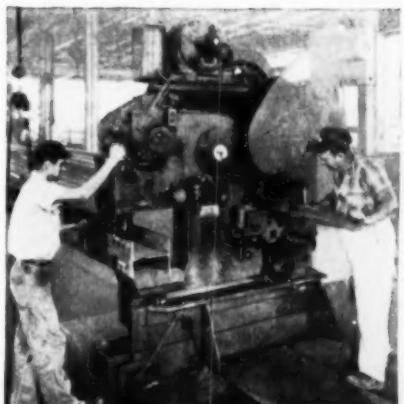
"BUFFALO" UNIVERSAL IRON WORKER — These construction details clearly show you why the "Buffalo" Universal Iron Worker does more jobs, does them better, faster, and lasts longer.

CUT, PUNCH, SHEAR, COPE, MITER AND NOTCH
WITH ONE MACHINE COST AND SPACE!

- **Low Initial Cost of *One* Machine!**
- **Versatile Output of *Six* Machines!**
- **Saves Labor, Setup and Production Time!**
- **Saves Productive Floor Space!**

Are you losing valuable time and floor space every day because you have several machines in different locations doing work which could be handled by a "Buffalo" Universal Iron Worker? This sturdy, dependable workhorse cuts, punches, shears, slits, copes, miters and notches at a very high output rate. The UIW quickly and easily handles angles, tees, channels, bars, flats. It's built to take plenty of punishment, too — with welded steel plate box frame, heavy shafts, bearings, bolsters and plungers. Centralized oiling system insures permanent proper lubrication.

See how the "Buffalo" Universal Iron Worker can profitably speed **your** operations. Phone your "Buffalo" machine tool dealer, or write for Bulletin 360-H for range of capacities and details.



Two Operations at Once!

Punching and shearing simultaneously on a "Buffalo" Universal Iron Worker.

All "Buffalo" products bring you the "Q" Factor—the built-in QUALITY which provides trouble-free satisfaction and long life.

BUFFALO FORGE COMPANY

509 BROADWAY • BUFFALO, N. Y.

Buffalo Pumps Division, Buffalo, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

DRILLING PUNCHING SHEARING BENDING

WILSON "ROCKWELL"

HARDNESS TESTERS

WORLD'S STANDARD OF ACCURACY

ACCO for Better Values

EQUIPMENT for EVERY Hardness Testing Requirement

No matter what your hardness testing requirements are, there's a WILSON "ROCKWELL" instrument to do the job. Choose from this complete selection of hardness testers:

"ROCKWELL"—for most hardness testing functions.

Superficial—for extremely shallow indentations.

Twintester—combines functions of "ROCKWELL" and "ROCKWELL" Superficial testers.

Semi-Automatic (manual feed) and Fully Automatic—for automatically classifying tested pieces as CORRECT, TOO HARD, or TOO SOFT—at test rates up to 1000 pieces per hour.

Special Machines—for testing large objects, obtaining internal readings, and other unusual applications.

ALL WILSON "ROCKWELL" hardness testers provide these advantages:

Accurate performance—precision built, with exact calibration, for consistently correct results.

Long life—durable as a machine tool.

Easy operation—even an unskilled operator can get perfect readings. All controls conveniently grouped.

Easy maintenance—interchangeable mechanisms, with spindles mounted on oil-less bearings.

DIAMOND "BRALE" PENETRATORS

for perfect testing every time

A perfect diamond penetrator is essential to accurate hardness testing. Since one point of hardness on the "ROCKWELL" scale represents only 80 millionths of an inch of penetration—only 40 millionths on a Superficial tester—the slightest imperfection will cause a false reading.

Only *perfect* Wilson Diamond Brale Penetrators are sold. Each diamond is flawless, with no chips or cracks. It's cut to an exact shape. Microscopic inspection and a comparator check of every diamond—one at a time—assure this perfection—and assure you of accurate hardness testing every time.

A COMPLETE LIBRARY of Helpful Information

A wide variety of bulletins tells about hardness testing, and describes the many instruments, accessories, and services Wilson offers. Write for your choice:

DH-325—WILSON "ROCKWELL" Hardness Testers • **DH-326**—"ROCKWELL" Superficial Hardness Testers • **DH-327**—Special "ROCKWELL" Testers, including Automatic and Semi-Automatic models • **DH-328**—TUKON Tester, for precision MICRO and MACRO testing

ACCO **WILSON**

MECHANICAL INSTRUMENT DIVISION

AMERICAN CHAIN & CABLE

230-B Park Avenue, New York 17, N.Y.

Bodine

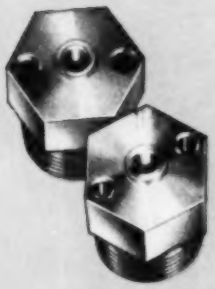
CASE HISTORY No. 49

showing what ONE versatile Bodine is doing for MANNING, MAXWELL & MOORE, Inc.

PARTS:
One is brass, the other tough AISI 347 Stainless Steel.

OPERATIONS:
Drill, chamfer and tap (#8-32) two holes 5/16" deep.

PRODUCTION:
Brass, 800/50 min. hour, Stainless, 175/50 min. hour.



PARTS:
Brass.

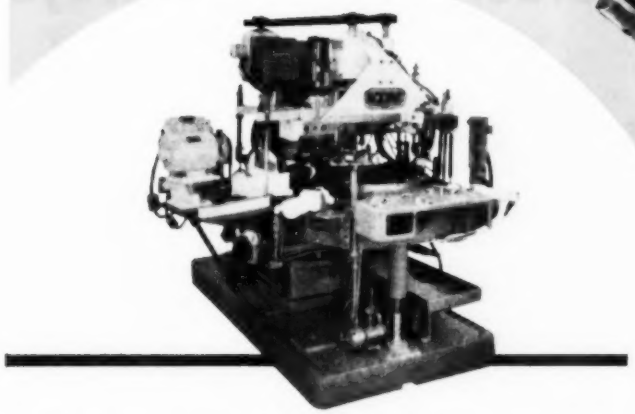
OPERATIONS:
Drill and countersink two holes, .173" dia. with .350", 82° countersink. Also drill and tap (#2-56) two holes.

PRODUCTION:
1500/50 min. hour.

PARTS:
Forged brass gauge-sockets.

OPERATIONS:
An unusual feature is two-step drilling of two holes . . . first 1/2-way through, using #37 (.104") half-round drills with bushings; then drill through and chamfer in one operation, using combination half-round drills. By this method tolerances on hole centers are held to ± .001" on the entry and ± .003" on exit side after drilling through 9/16" of stock. Tap same two holes #6-32 9/32" deep. Mill slot .135" (± .002") wide x .156" deep with horizontal milling spindle and 4" saw-type cutter. Drill hole from bottom of milled slot #44 (.086), 5/16" deep.

PRODUCTION:
Position and clamp; auto unclamp and auto eject; 1250 pieces per 50 min. hour.



PART:
Stainless Steel (AISI 347).

OPERATIONS:
Drill, chamfer and tap (#2-56) two holes 3/16" deep.

PRODUCTION:
150/50 min. hour.

All these parts and operations on ONE machine with only TWO dial changes!

Here is a good example of Bodine versatility . . . and especially of the ability of a single Bodine Basic Machine to handle exacting jobs of widely differing shapes, sizes, materials and operations . . . with changeover reckoned in minutes rather than hours.

All of these parts are processed with only two dial changes. Spindles, other accessory equipment, and tooling are also basically standardized Bodine units. Retooling for possible future part and operation changes will be relatively simple and inexpensive . . . an important Bodine feature.

Isn't this the kind of time-saving, cost-cutting production engineering you, too, are looking for? If so, do not hesitate to ask us for production analysis of your next job. Write Dept. AM-3.

THE **Bodine** CORPORATION

BRIDGEPORT 5, CONNECTICUT

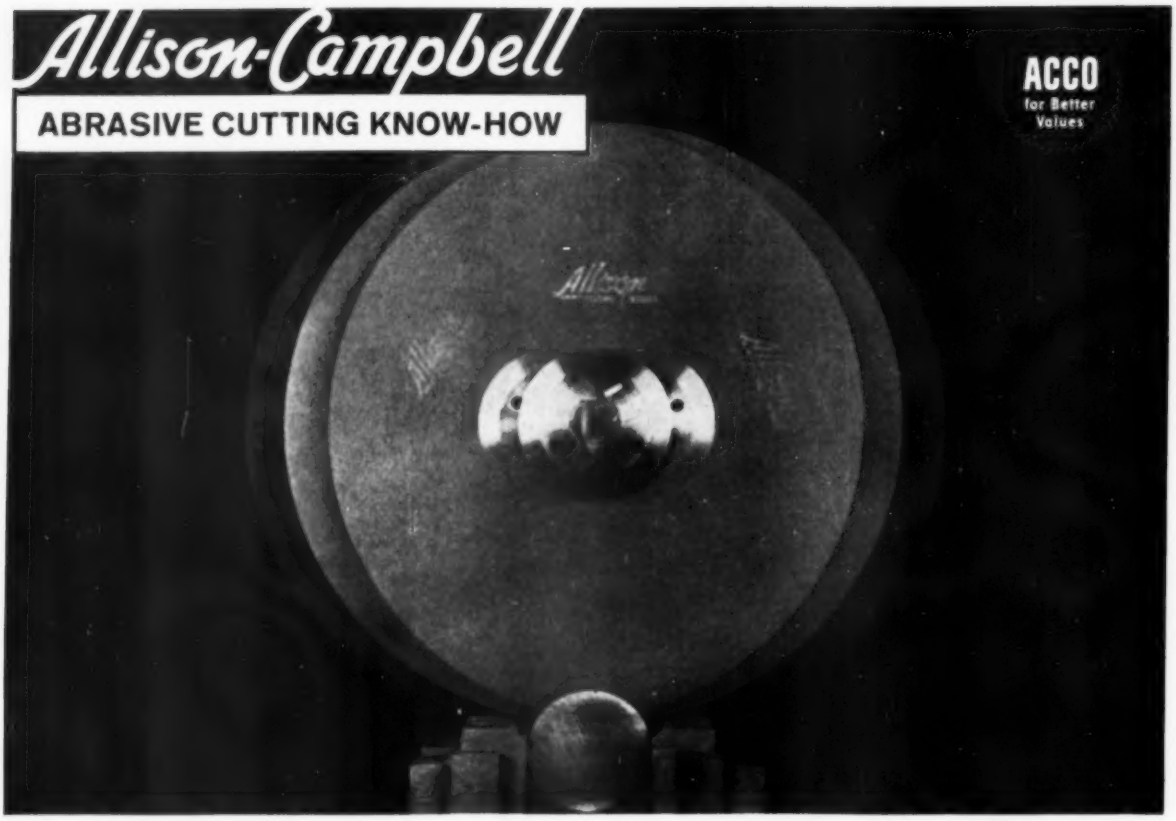
AUTOMATIC DIAL TYPE DRILLING, MILLING, TAPPING, AND SCREW INSERTING MACHINES

18D59

Allison-Campbell

ABRASIVE CUTTING KNOW-HOW

ACCO for Better Values



Oscillation Improves Abrasive Cutting 4 Ways

On an oscillating-type abrasive cut-off machine, the cutting wheel is rocked back and forth *across* the cut while the wheel is fed downward. This horizontal movement produces some remarkable results.

1 **Greater cutting capacity** is one big advantage of oscillation. Because oscillation reduces the arc of contact between the wheel and the work, it is possible to cut solid steel bars up to 12" square. Without oscillation, 2" to 3" would be the practicable limit.

2 **Faster cutting** is another benefit of oscillation. Because the reduced arc of contact offers less resistance to the cutting wheel on large sections, the same wheel cuts faster, straighter, and with less feed pressure. Cutting rates of 4 to 8 seconds per square inch are maintained on even the largest cross-sections.

3 **Better quality cuts** are obtained with oscillation. Less heat is generated because of the small arc of contact, and the rocking action permits coolant to enter the cut more easily and prevent any heat build-up.

Burn-free cuts are produced with negligible burr, and there is little or no need for further finishing.

4 **Longer wheel life** is an important economy factor. The lower cutting temperature resulting from oscillation adds extra cuts to the life of every wheel.

The better flow of coolant within the cut washes away metal chips and loose abrasive, helping wheel efficiency.

HOW ALLISON-CAMPBELL CAN HELP

A complete selection of machines and wheels for *any* cut-off application is offered by ALLISON-CAMPBELL. Four types of CAMPBELL machines—chop stroke, oscillating, horizontal, and rotary—in capacities from the smallest stock to 14" rounds . . . billets up to 12" square . . . plate up to 6" thick and 20 ft. long. ALLISON wheels—more than 150 different specifications—rubber or resinoid bond—3" to 34" diameters—.006" to 3/16" thick.

Expert recommendations from your ALLISON-CAMPBELL Field Engineer can solve your cut-off problems for you. He'll be glad to show you how to get the faster, cleaner cuts you can expect from modern abrasive cutting techniques. Ask him.

WRITE FOR NEW BULLETIN

• Individual analysis of your cutting problems can be made in the new ALLISON-CAMPBELL Demonstration Laboratory. Write for a copy of DH-20, a new bulletin which describes how you can use these facilities. Complete details on ALLISON wheels and CAMPBELL machines are also available.

ALLISON-CAMPBELL DIVISION
AMERICAN CHAIN & CABLE

923 Connecticut Avenue, Bridgeport 2, Conn.

ACCO

A Winning Combination...

"American" HOLE WIZARD RADIAL + INGENIOUSLY DESIGNED FIXTURES

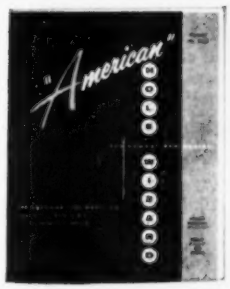
The time on this job was cut to the bone by the combination shown by the illustration. All boring, facing, drilling, tapping and counterboring on the entire job was done in one work setting by means of an ingenious swiveling fixture.

The essential contributor to satisfactorily performing this variety of work is unquestionably the "AMERICAN" Double Lo-Hung Spindle Drive. This is an exclusive "AMERICAN" Hole Wizard feature. It divides the speed range into two separate ranges; the high speeds through a comparatively small gear to minimize gear velocities; the low speeds through a large diameter, wide faced gear to reduce gear tooth pressures to insure minimized wear under severe service.

To further reduce wear and to insure maintenance of original accuracy the spindle and sleeve are made of nitralloy steel nitrided for extreme surface hardness and are mounted on large precision Timken Bearings with convenient outside adjustment which guarantees maximum life, dependable operation and unequalled spindle stability for the life of the machine.

These exclusive "American" features permit your putting your radial drills to work at a profit

There are other advantages too — write for bulletin No. 328.



THE AMERICAN TOOL WORKS CO. Cincinnati 2, Ohio, U. S. A.

LATHES AND RADIAL DRILLS

CIRCLE 207 READER SERVICE CARD

POP'S school of Sawing

WHADDYA MEAN—ALL ALIKE? THESE HAVE NICHOLSON ON 'EM. THAT MEANS ALL THE DIFFERENCE IN THE WORLD!
DON'T KNOW ABOUT HIM— BUT THAT'S ALL I GOTTA SEE. I'VE TRIED 'EM MYSELF AND THEY'RE TERRIFIC!
YOU CAN SAY THAT AGAIN.
STAN RANDALL

At last you can tell what a hacksaw or band saw blade will do just by looking at it. You know you can expect outstanding performance and low cost—when you see a Nicholson trademark.

These are the things Nicholson trademarks have always meant. These are the reasons the Nicholson and Black Diamond names are respected and wanted.

Save metal cutting time and costs. And increase your production. Standardize on Nicholson Hand and Power Hacksaw Blades and Nicholson Band Saw Blades. Black Diamond Hand Hacksaw Blades also are available.

Selected Distributors now offer these new Nicholson and Black Diamond Blades. Ask to test the types you use.

Industrial Distributors provide the finest goods and services in the least possible time. Our products are sold exclusively through them.

NICHOLSON METAL SEPARATING BLADES ARE AVAILABLE IN THESE TYPES

HAND HACKSAW BLADES

Flexible High Speed Molybdenum	Standard Steel
All Hard Molybdenum	All Hard Standard
All Hard Tungsten	Special Shatterproof

POWER HACKSAW BLADES

Welded Edge Shatterproof	All Hard Molybdenum
Flexible High Speed Steel	All Hard Tungsten—18-4-1

BAND SAW BLADES

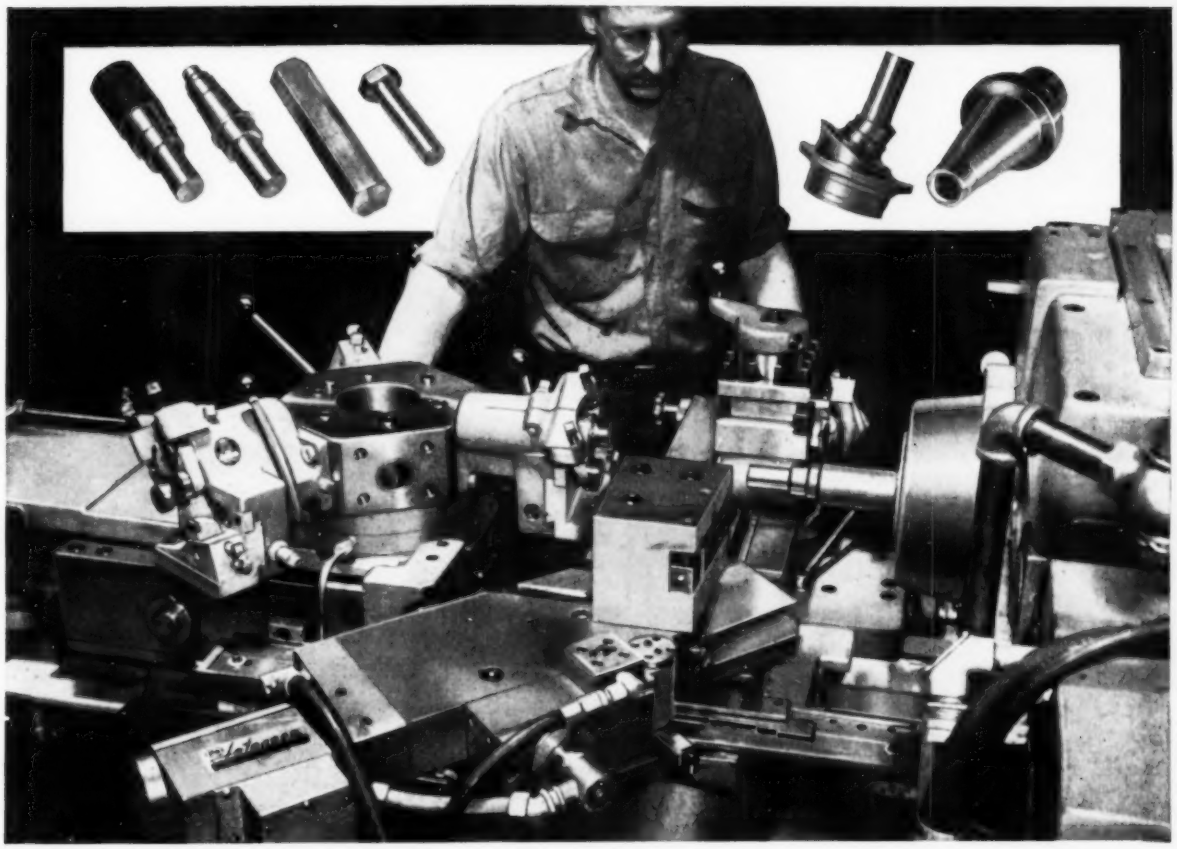
Magicut—Raker and Wavy Set · Hook Tooth · Skip Tooth

NICHOLSON U.S.A. NICHOLSON BLACK DIAMOND U.S.A.

Nicholson File Company, Providence, Rhode Island

FILES • ROTARY BURS • HACKSAW AND BAND SAW BLADES • GROUND FLAT STOCK • INDUSTRIAL HAMMERS

Want to cut costs on parts like these?



Here's how tracing will help you save

The simple, basic setup shown above handles nearly 300 different parts for a well-known manufacturer of drive line components. All work is performed on one Gisholt MASTERLINE No. 4 Ram Type Turret Lathe with a JETracer on the rear of the cross slide. Standard tools on the hex and square turrets are used to face, chamfer and reduce the stock while the JETracer finishes all diameters, steps, blends and radii. The 6 9/16"-long, 2"-diameter stepped shaft (above at left) is typical and is completed in two operations with total f.t.f. time only 4.95 minutes.

Here are just a few things the JETracer can do for you:

- Shorten setup and change-over time
- Simplify machining and eliminate operator errors
- Save cost of form tools, multiple tool blocks and holders
- Reduce inspection time (only one length and one diameter need checking)
- Minimize or eliminate secondary operations (through finer finish, greater accuracy)
- Increase production through automatic machining of complex surfaces
- Free operator to handle extra units or perform other work

Gisholt has developed a complete line of JETracers for use with ram and saddle type turret lathes, automatic turret lathes and single-spindle chucking lathes. These include rear cross slide, turret and independent slide mounted units, single or multi-pass types. *All are designed to operate at full capacity of the machines to which they are applied, without limiting machine functions or restricting the use of standard tools.*

You'll want to see for yourself how the JETracer adds flexibility, speeds operations and cuts costs on standard and problem parts. Send the coupon today for your free copy of the new JETracer catalog, or call your Gisholt Representative for complete information.

GISHOLT MACHINE COMPANY
Madison 10, Wisconsin

ASK YOUR GISHOLT REPRESENTATIVE ABOUT FACTORY-REBUILT MACHINES WITH NEW-MACHINE GUARANTEE

GISHOLT MACHINE COMPANY
1201 E. Washington Avenue
Madison 10, Wisconsin

Please send a copy of the new Gisholt JETracer catalog.

Name..... *Title*.....

Company.....

Street address.....

City..... *Zone*..... *State*.....

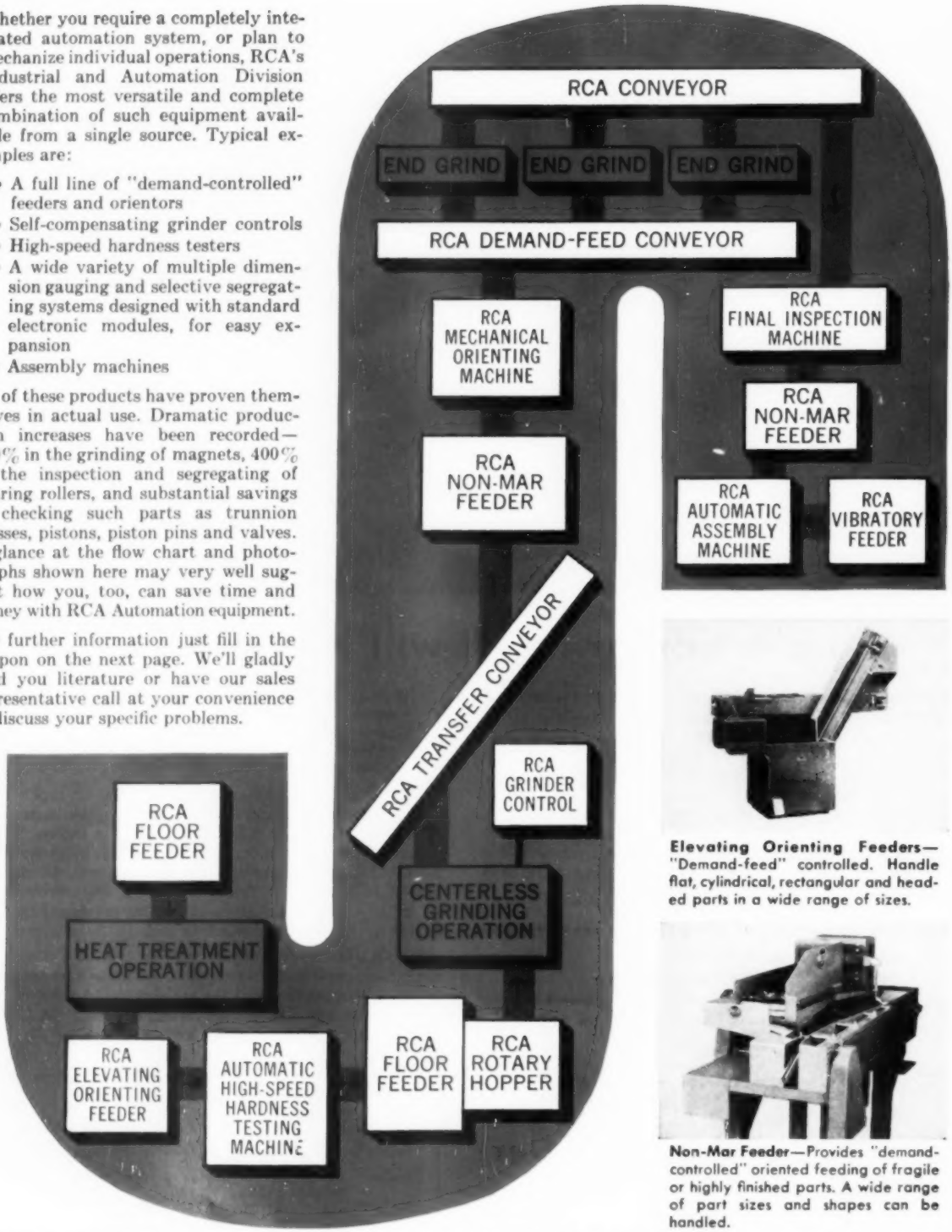
REDUCE COSTS . . . INCREASE PRODUCTION

Whether you require a completely integrated automation system, or plan to mechanize individual operations, RCA's Industrial and Automation Division offers the most versatile and complete combination of such equipment available from a single source. Typical examples are:

- A full line of "demand-controlled" feeders and orientors
- Self-compensating grinder controls
- High-speed hardness testers
- A wide variety of multiple dimension gauging and selective segregating systems designed with standard electronic modules, for easy expansion
- Assembly machines

All of these products have proven themselves in actual use. Dramatic production increases have been recorded—200% in the grinding of magnets, 400% in the inspection and segregating of bearing rollers, and substantial savings in checking such parts as trunnion crosses, pistons, piston pins and valves. A glance at the flow chart and photographs shown here may very well suggest how you, too, can save time and money with RCA Automation equipment.

For further information just fill in the coupon on the next page. We'll gladly send you literature or have our sales representative call at your convenience to discuss your specific problems.



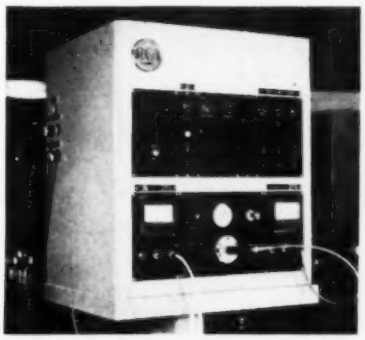
Elevating Orienting Feeders—"Demand-feed" controlled. Handle flat, cylindrical, rectangular and headed parts in a wide range of sizes.

Non-Mar Feeder—Provides "demand-controlled" oriented feeding of fragile or highly finished parts. A wide range of part sizes and shapes can be handled.

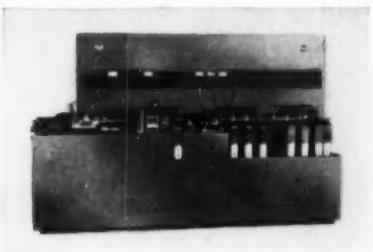
BACKED BY YEARS OF EXPERIENCE IN

WITH RCA "BUILDING-BLOCK" AUTOMATION

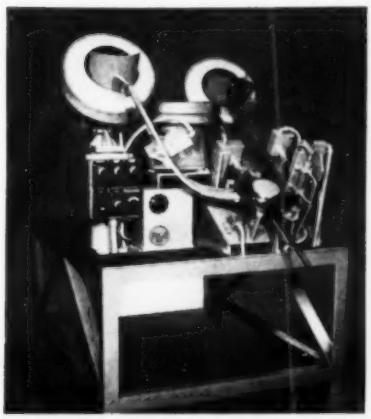
Automatic High-Speed Hardness Testing Machines—Inspect up to 2500 parts per hour with laboratory accuracy.



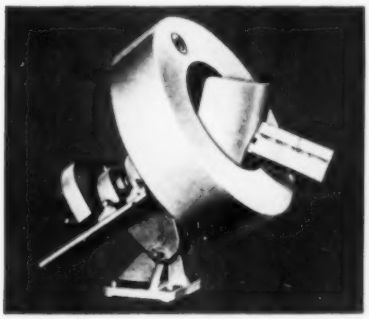
Centerless Grinder Control—Accurate to .000050", RCA self-compensating grinder controls can be used in rough as well as finish operations. Extreme reliability and 100% repeatability are reported by users.



Final Inspection Machines—Equipment similar to the one above, inspect O.D., I.D., length, taper, true roundness. They also provide automatic segregation of inspected parts into almost any desired number of categories, as well as stamping and counting.



Automatic Assembly Machines—This unit automatically assembles bolts and lock washers. It is one of the many assembly machines developed by RCA.



Rotary Hopper—Exceptionally low in cost, RCA rotary hoppers are available with 18", 24", and 30" bowls. RCA orienting discharge tracks for various part sizes and shapes are mounted on the hopper by merely loosening and tightening one screw.

Floor Feeders—High-Speed, "demand-feed" control, broad versatility in parts handled, and large storage capacity make these units ideal for integrating machine operations.

Mail coupon below for further facts

RCA

Tmk(s) ®

RADIO CORPORATION of AMERICA

INDUSTRIAL AND AUTOMATION DIVISION
DETROIT, MICHIGAN

Radio Corporation of America
Industrial and Automation Division, Dept. RB-139
12605 Arnold Avenue, Detroit 39, Michigan

Please send me complete information on RCA Industrial Automation equipment for the following purposes:

_____

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NAME_____ TITLE_____

COMPANY_____

ADDRESS_____

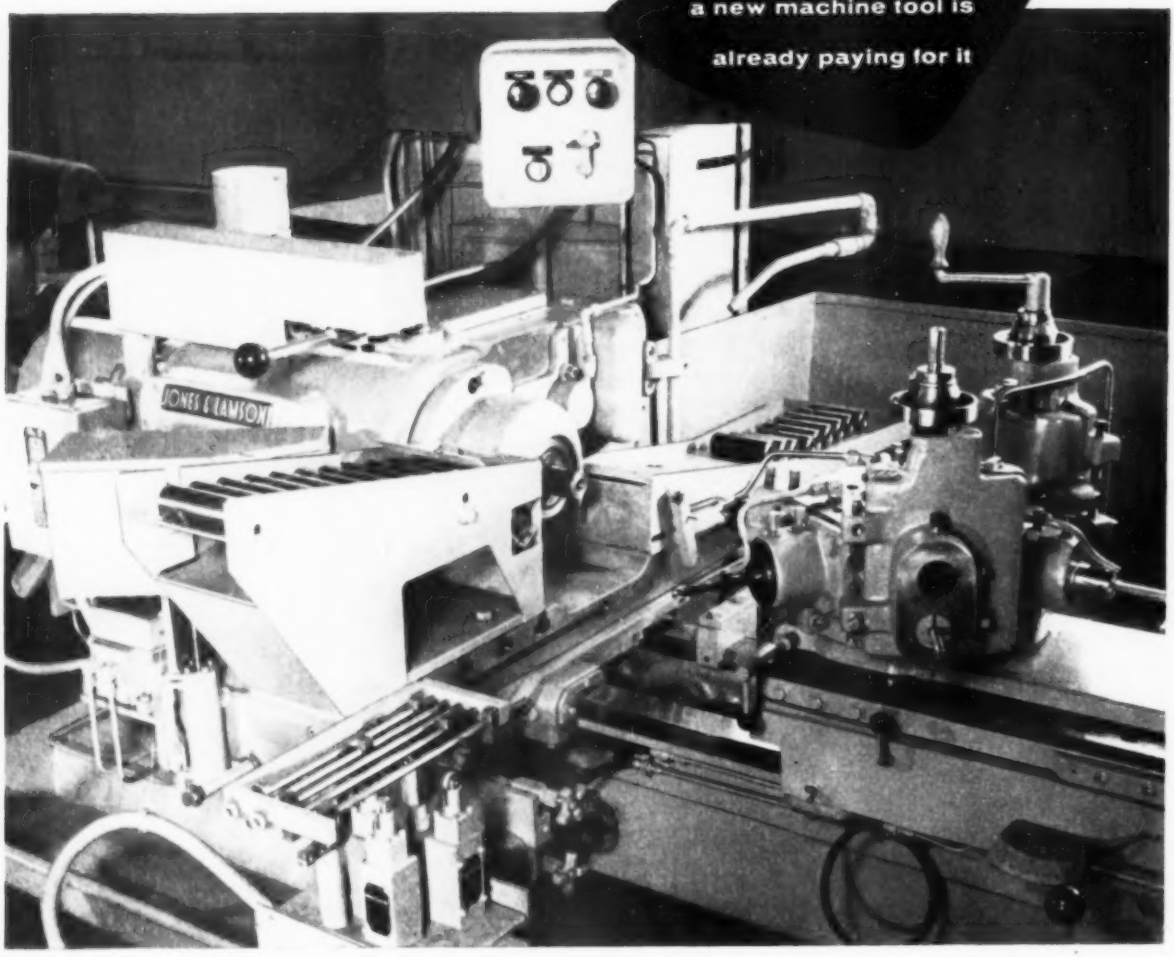
CITY_____ ZONE_____ STATE_____

☐ Have Representative Call.

ELECTRONICS AND AUTOMATIC CONTROL

JONES & LAMSON "AUTOMATION"

the man who needs a new machine tool is already paying for it

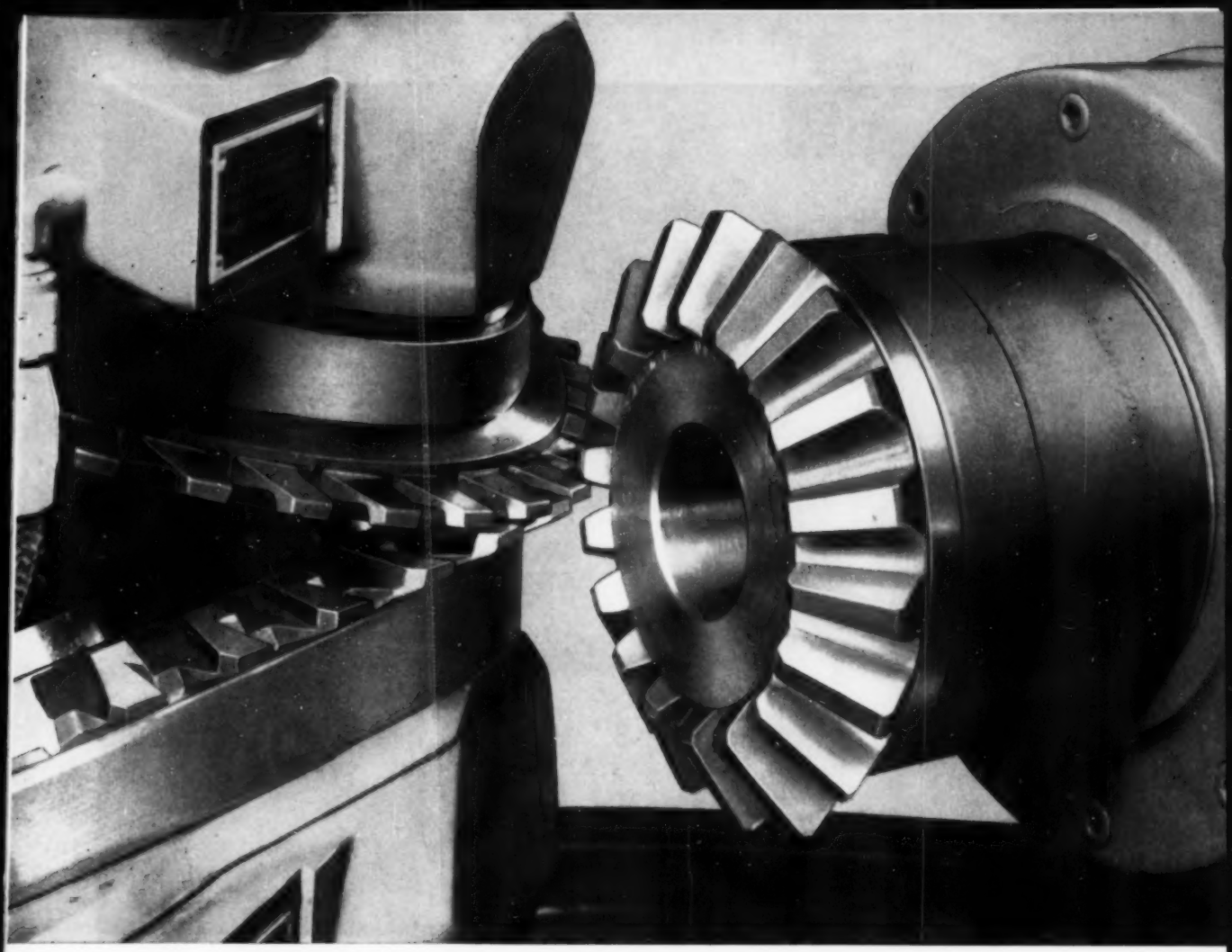


Fully Automatic Turret Lathe operation reduces machining costs by 32%

This J & L Automatic Ram Type Turret Lathe with Lynn Hydraulic drive provides completely automatic operation from start to stop. A magazine feed for automatic work handling has been mounted on the cross slide. However, on applications where cross slide tooling is necessary, handling devices can be arranged that will free either the front or rear of the cross slide for tooling.

Fourteen similar parts of varying dimensions are produced on this same machine. The tooling used is basically the same as that used in the former, hand-operated method. However, on machining time alone, costs are reduced by 32%. Operator attention for this set-up is only one-third of that previously required. In addition, studies show that one operator can run two or more of these automatics with less fatigue than is involved in running one manual machine. Needless to say, J & L's long-standing reputation for turret lathe accuracy is retained throughout. Write for catalog 5808. Jones & Lamson Machine Company, 502 Clinton Street, Springfield, Vermont.

Turret Lathes • Automatic Lathes • Tape Controlled Machines • Thread & Form Grinders • Optical Comparators • Thread Tools



How to complete gears up to 16″ O.D. in one cut from the solid

The Gleason No. 114 Straight Bevel Coniflex® Generator cuts gears directly from the solid in diameters up to 16″, up to $2\frac{1}{2}$″ face width and $2\frac{1}{2}$ diametral pitch.

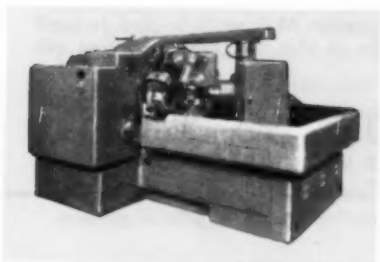
With it you obtain much faster production rates—up to five times faster than with other methods. Still it retains a basic flexibility which permits quick changeovers from one job to another.

Excellent quality. Even with the speed of the No. 114 Coniflex Generator, quality remains excellent. It provides a smooth blend of root, fillet, and tooth flank—your assurance of strong, accurate teeth.

Coniflex gears give localized tooth bearing, too, assuring practical assembly tolerances.

Simplified calculations. You can do all calculations with a slide rule. You can also control tooth bearing easily to suit various operating conditions or to set up interchangeability with existing gears.

For more details on the No. 114, write for bulletin.



GLEASON WORKS

1000 UNIVERSITY AVE., ROCHESTER 3, N. Y.

CIRCLE 213 READER SERVICE CARD

Introducing the NEW MODEL 1-A SEVER-ALL Machine... CUTS AT 3 to 6 SECONDS PER SQUARE INCH—ECONOMICALLY

MANY EXTRA FEATURES AT A DELIVERED COST UNDER $500

You get the cut quality and capacity of machines nearly three times as expensive when you use the new Model 1-A SEVER-ALL oscillating dry abrasive cut-off machine. Available from your distributor's stock. Here's why the #1-A SEVER-ALL is ideal for industrial and machine shop operations:

BIG CAPACITY • Up to 2" square solids, $3\frac{1}{2}$" O. D. pipe and tubing, 3" angle iron, and 4" channels . . . of cold rolled, stainless, and alloyed steel; cast iron; and nonferrous metals. Wheel oscillation, an exclusive feature in this price range, provides this *above-average* capacity.

SPEED • Cuts a 2" x 2" hardened steel bar in 16 seconds . . . other shapes and sizes at 3 to 6 seconds per square inch.

QUALITY • Clean, smooth cuts, even on large sections, because wheel oscillation provides cooler cutting.

ECONOMY • In addition to low initial cost, the Model 1-A SEVER-ALL is inexpensive to operate . . . occupies minimum floor space . . . requires little or no set-up time . . . eliminates annealing costs . . . gives more cuts per wheel because of oscillation.

SIMPLICITY • Just two SEVER-ALL cutting wheel specifications will do *all* your SEVER-ALL cutting jobs. A positive, screw-type vise holds all regular shapes, and an adjustable work stop provides speed and accuracy.

ANGLE CUTS • Optional accessory permits cutting angles up to 45° in either direction.

NEW SEVER-ALL AVAILABLE FROM DISTRIBUTORS

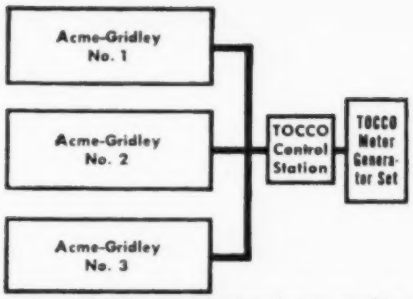
Very likely your own distributor already stocks the Model 1-A SEVER-ALL machine and wheels. If not, let us know, and we'll give you the name of your nearest SEVER-ALL distributor. Also, we'll be glad to send you complete details on this new machine. Just ask for **Bulletin DH-106.**

ALLISON-CAMPBELL DIVISION
AMERICAN CHAIN & CABLE

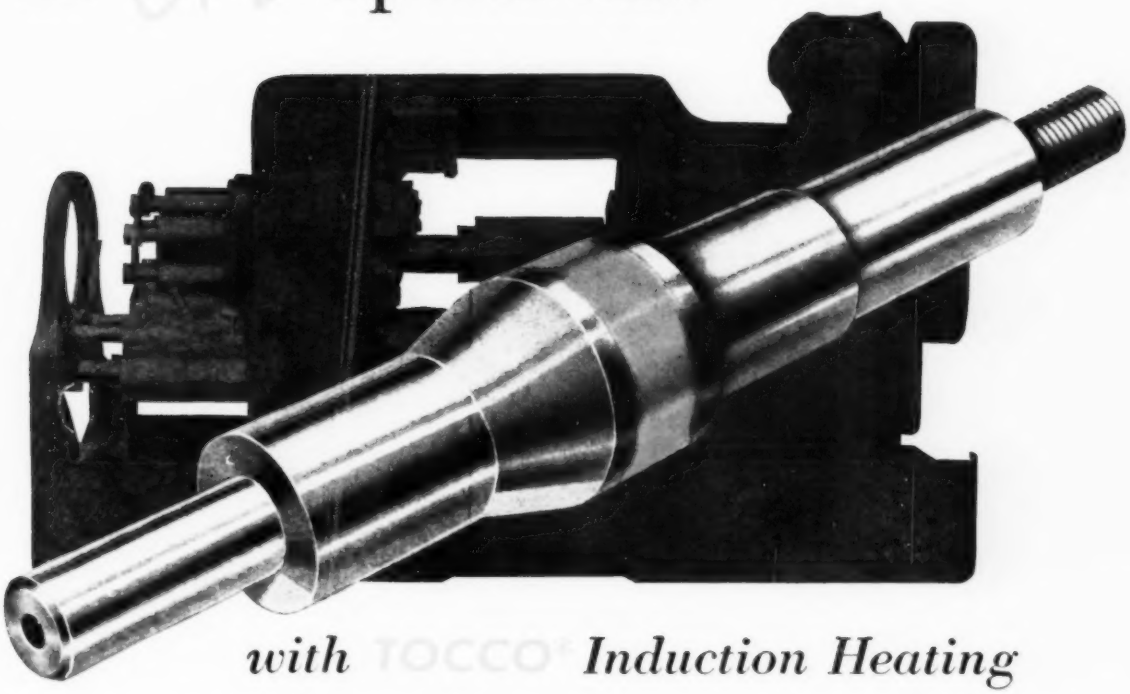
ACCO

923-S Connecticut Avenue, Bridgeport 2, Conn.

Pump Shafts Machined and Hardened in ONE operation...



Plan view of TOCCO-equipped automatic screw machine installation for hardening collars on vane pump shafts.



with TOCCO Induction Heating*

TOCCO-equipped 8-spindle Acme-Gridley Screw Machines at a large automotive manufacturer's plant produce vane pump shafts for power steering units in one completely automatic operation! The hardening and metal-working operations are combined on the same machine.* No additional handling—no hardening cost except power!

A TOCCO inductor, mounted at one station of each automatic, hardens collars on pump shafts after they have been completely machined at preceding stations on the same machine. Each installation consists of 3 automatic machines equipped with inductor coils powered by a 50 KW, 10,000 cycle TOCCO unit. Production from each installation is 360 shafts per hr.

Shafts are made of C 1144 and only the collar is hardened to prevent scoring the seal. TOCCO's rapid heating confines the hardened area to the surface of the collar leaving the rest of the shaft unaffected.

If your products or their components require heat treating, soldering, brazing or heating for forging, it will pay you to investigate TOCCO for better, faster production at lower unit costs.

*A Patented Process

THE OHIO CRANKSHAFT COMPANY

Mail Coupon Today—NEW FREE Bulletin

The Ohio Crankshaft Co. • Dept. B-3, Cleveland 5, Ohio

Please send copy of "Typical Results of TOCCO Induction Hardening and Heat Treating."

Name_____

Position_____

Company_____

Address_____

City_____ Zone____ State_____

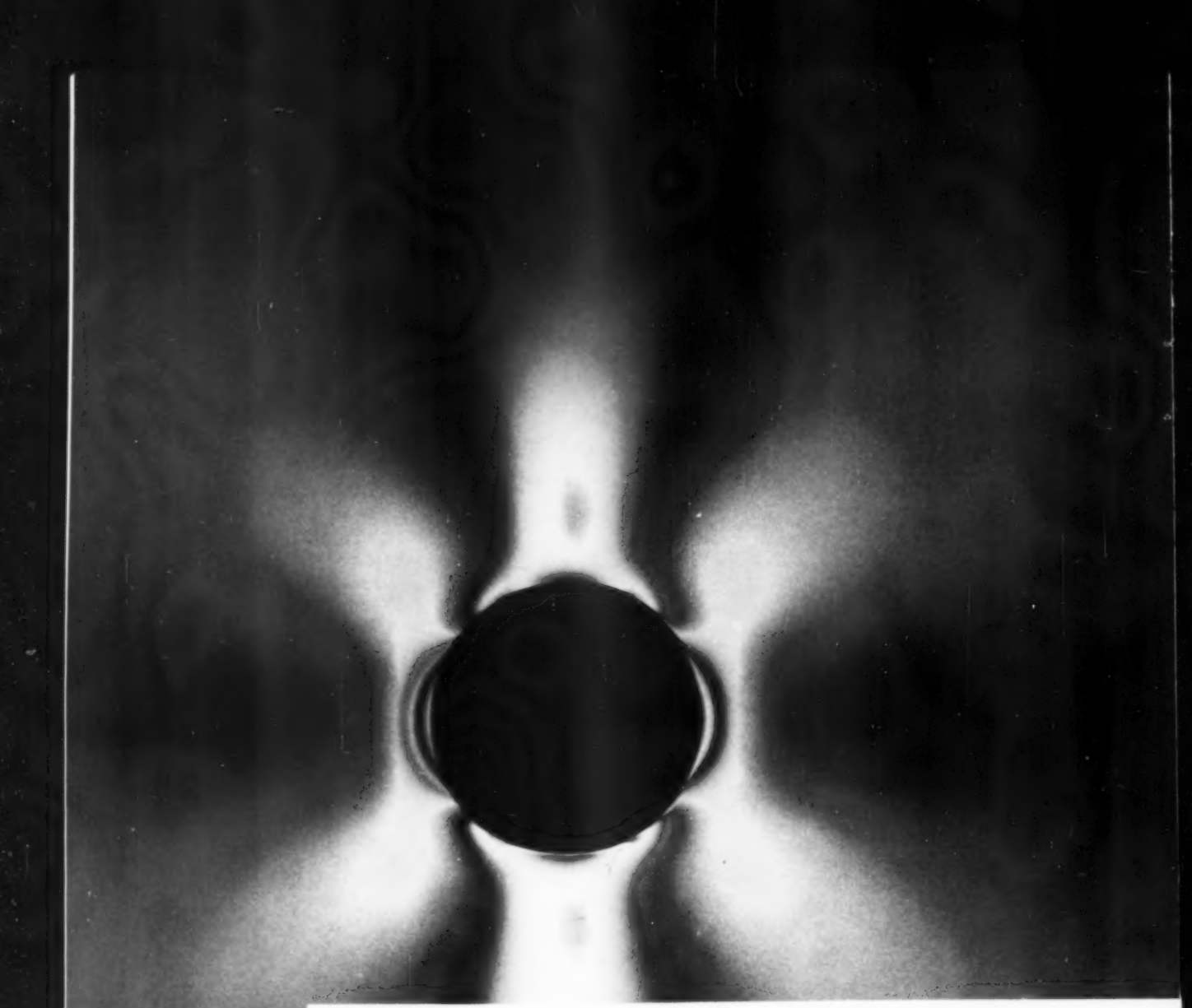


Photo-elastic stress patterns produced by models photographed with polarized light are one of the modern analytic tools available for ever-increasing perfection of Malleable iron castings.

Strength is Malleable

The strength crucial in spiraling the heave of diesels' pistons into unresistible power, in protecting lives as automobiles hurtle down endless highways, and in every link of chain that swings massive loads overhead, is yours to mold into tomorrow's dynamic engineering achievements with Malleable iron castings. Yet Malleable provides this strength in combination with toughness, producibility and economy that makes Malleable castings the finest, most versatile metal available.

For information or service, call on one of the progressive firms that identify themselves with this symbol—

MEMBER

MALLEABLE

CASTINGS COUNCIL

If you wish, you may inquire direct to the Malleable Castings Council, 1800 Union Commerce Building, Cleveland 14, Ohio, for information.

These companies are members of the

MALLEABLE CASTINGS COUNCIL

CONNECTICUT
Connecticut Mall. Castings Co., New Haven 6
Eastern Malleable Iron Co., Naugatuck
New Haven Malleable Iron Co., New Haven 4

DELAWARE
Eastern Malleable Iron Co., Wilmington 99

ILLINOIS
Central Fdry. Div., Gen. Motors, Danville
Chicago Malleable Castings Co., Chicago 43
Moline Malleable Iron Co., St. Charles
National Mall. and Steel Castings Co., Cicero 50
Peoria Malleable Castings Co., Peoria 1
Wagner Castings Company, Decatur

INDIANA
Link-Belt Company, Indianapolis 6
Muncie Malleable Foundry Co., Muncie
Terre Haute Mall. & Mfg. Corp., Terre Haute

MASSACHUSETTS
Belcher Malleable Iron Co., Easton

MICHIGAN
Albion Malleable Iron Co., Albion
Auto Specialties Mfg. Co., Saint Joseph
Cadillac Malleable Iron Co., Cadillac
Central Fdry. Div., Gen. Motors, Saginaw

MINNESOTA
Northern Malleable Iron Co., St. Paul 6

NEW HAMPSHIRE
Laconia Malleable Iron Co., Laconia

NEW JERSEY
Meeker Foundry Company, Newark 4

NEW YORK
Acme Steel & Mall. Iron Works, Buffalo 7
Frazer & Jones Company Division Eastern Malleable Iron Co., Solvay
Oriskany Malleable Iron Co., Inc., Oriskany
Westmoreland Mall. Iron Co., Westmoreland

OHIO
American Malleable Castings Co., Marion
Canton Malleable Iron Co., Canton 5
Central Fdry. Div., Gen. Motors, Defiance
Dayton Mall. Iron Co., Ironton Div., Ironton
Dayton Mall. Iron Co., Ohio Mall. Div., Columbus 16
Maumee Malleable Castings Co., Toledo 5
National Mall. and Steel Castings Co., Cleveland 6

PENNSYLVANIA
Buck Iron Company, Inc., Philadelphia 22
Erie Malleable Iron Co., Erie
Lancaster Malleable Castings Co., Lancaster
Lehigh Foundries Company, Easton
Meadville Malleable Iron Co., Meadville
Pennsylvania Malleable Iron Corp., Lancaster

TEXAS
Texas Foundries, Inc., Lufkin

WEST VIRGINIA
West Virginia Mall. Iron Co., Point Pleasant

WISCONSIN
Badger Malleable & Mfg. Co., S. Milwaukee
Belle City Malleable Iron Co., Racine
Chain Belt Company, Milwaukee 1
Federal Malleable Company, West Allis 14
Kirsh Foundry Inc., Beaver Dam
Lakeside Malleable Castings Co., Racine
Milwaukee Malleable & Grey Iron Works, Milwaukee 46

How Machinability of Malleable Castings Increases Strength Per Dollar

In manufacturing metal parts, two questions always arise; "Will the material do the job?" and "How much will it cost?" With tensile strengths from 50,000 p. s. i. to 120,000 p. s. i. available in modern Malleable irons, plus extraordinary toughness, ductility and machinability, Malleable castings are uniquely qualified to "do the job."

But more important in today's competitive market is "How much will it cost?" Here, machining plays a very important part. First, many machining operations are eliminated, because with castings the metal is placed only where it is needed. Second, Malleable is the most machinable of all ferrous metals of similar hardness, so every machining operation is done faster with less tool and power consumption. The money saved by Malleable's greater machinability cuts finished costs to the point where Malleable provides more strength per dollar than any other metal, ferrous or nonferrous.

Example Demonstrates Machining's Importance

The T-bolt shown in Fig. 1 is used to assemble steel channel frames. Small but mighty, these 7/16" bolts hold 4 ton loads. Tensile strength requirements are 90,000 p. s. i. to 100,000 p. s. i. This part requires metal that has good ductility, holds to close tolerances, guarantees uniform properties bolt after bolt and offers production economy.

The T-bolt is a pearlitic Malleable sand casting 1.42" long and 1.12" across. The head, which must slip through the channel opening, is coined to a tolerance of .010" on its .475" width. Coining Malleable is a common and easy operation and, in this case, guarantees tolerances and assures a tight jig fit for the threading operation.

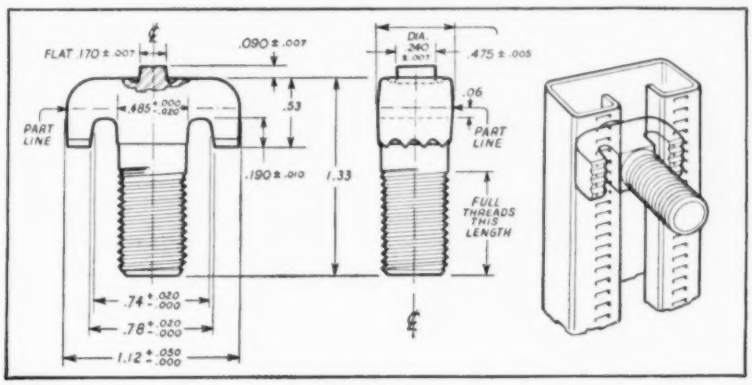


Fig. No. 1

Close Tolerances Held with Malleable Castings

Two other dimensions are critical. Tolerances on the distance between the teeth and the shank must be held to +.020" and —.000" each side. This assures proper fit in the channel. The protrusion on top of the head must be kept between .233" and .247". Both of these dimensions are met in the as-cast state. Costly machining is completely eliminated.

The T-bolt is threaded on a two place automatic lead screw tapping machine. Using standard chasers and soluble oil, finish 7/16-20-UNF threads are cut at the rate of 1,250 pieces per hour without previous hollow milling. Even though considerable metal is removed at the top of the thread, tool life and power consumption are good.

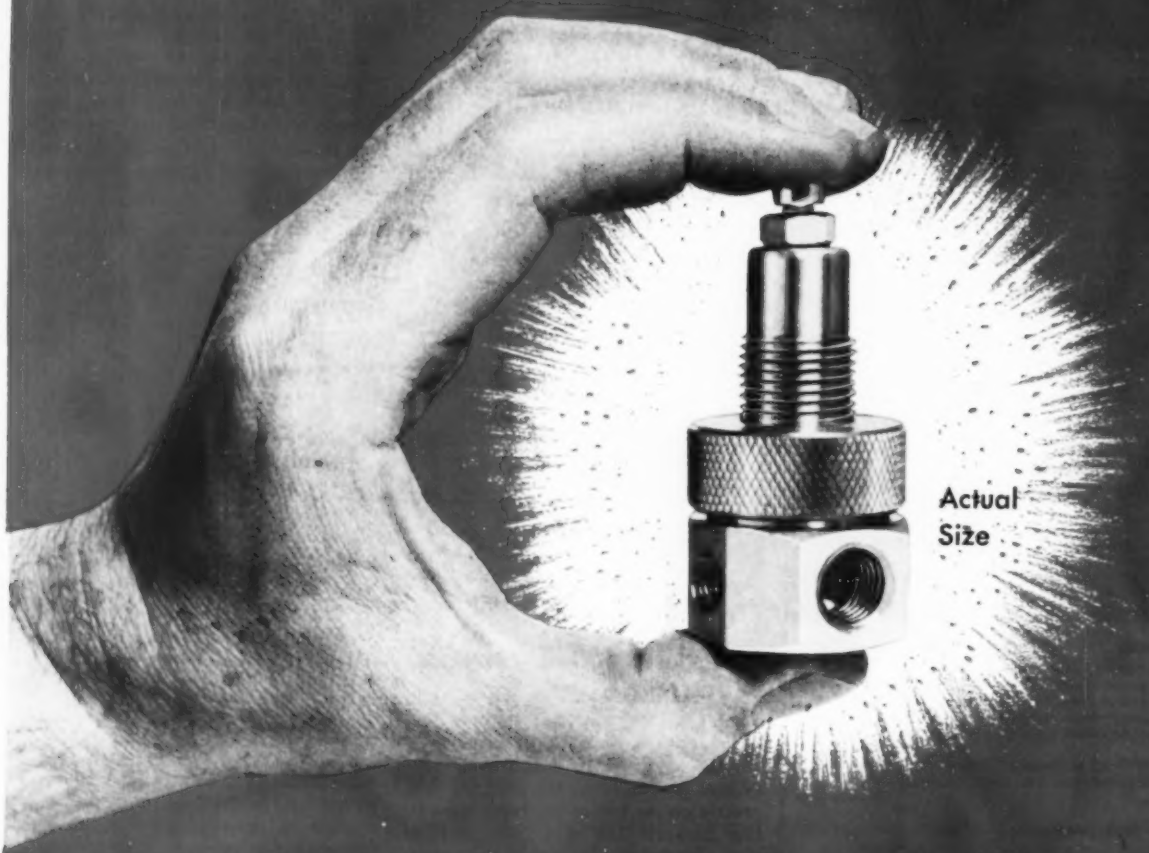
Attachment of a coil spring to the top of the head is the final operation. This is done by positioning the spring and upsetting the protrusion in a simple staking press operation. This is the operation that requires good ductility. Elongation must be 5 to 6% to permit good upsetting.

Malleable's superior machinability, plus the elimination of many machining operations, produced these parts for one-third less than the previous material.

Write for Free Data Unit

Data Unit 102-Strength, more fully describing Malleable's strength characteristics, is available for use by materials specifiers and users. For your copy, contact any member of the Malleable Castings Council or write to Malleable Castings Council, Union Commerce Building, Cleveland 14, Ohio.

NEW



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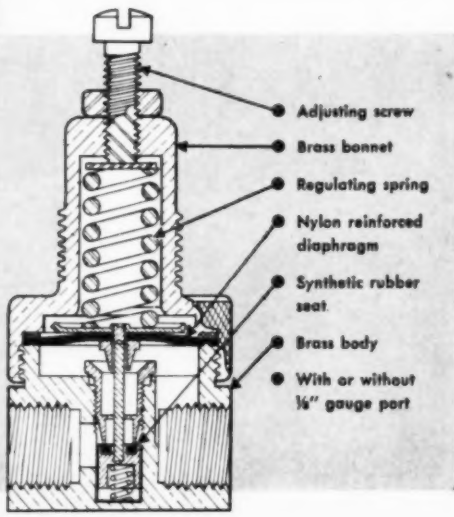

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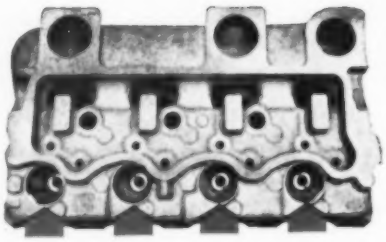
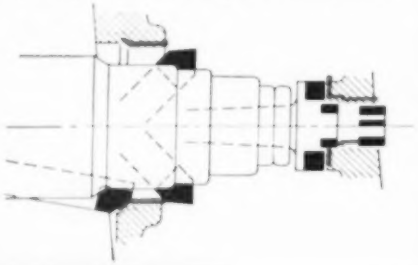


MACHINES 21 CYLINDER HEAD SURFACES IN ONE PASS WITH DEPTH OF CUT BETWEEN 1/8" AND 3/16"
Rough castings are bored, plunge-faced and chamfered at a rate of 18 parts per hour. Tooling is shown below.



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Heavy-Duty Precision Boring Machine

From base to bridge-top, Ex-Cell-O's new Style 771 Precision Boring Machine is engineered to keep pace with changing production needs and built to give years of precise profitable performance.

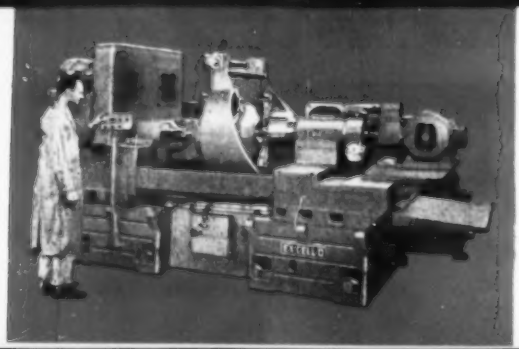
A specialist in fast, heavy-duty work such as the multiple machining operations detailed at left, the Style 771 (and the companion double-end Style 772) provides ample work space for complex tooling setups and bulky fixtures.

In-built versatility permits a broad range of rough, semi-finish and finish operations with automatic cycling. Rigid construction gives the "beef" needed for machining large, heavy parts, and supplies a wide margin of steadiness for high production of smaller precision parts.

Ex-Cell-O Precision Boring Machines can put greater precision into your products at lower per-unit cost. Get the full story from your local Representative, or write direct.

RIGHT: Style 771 machines both 4-and-6-cylinder tractor components. As cycle starts, table rapids to left, spindles rotate and feed traverse begins. At end of stroke, table rapids out to clear tooling; fixture indexes, cycle repeats for second set of holes.

BELOW: Double-end Style 772 performs multiple machining operations on tractor gear case cover.



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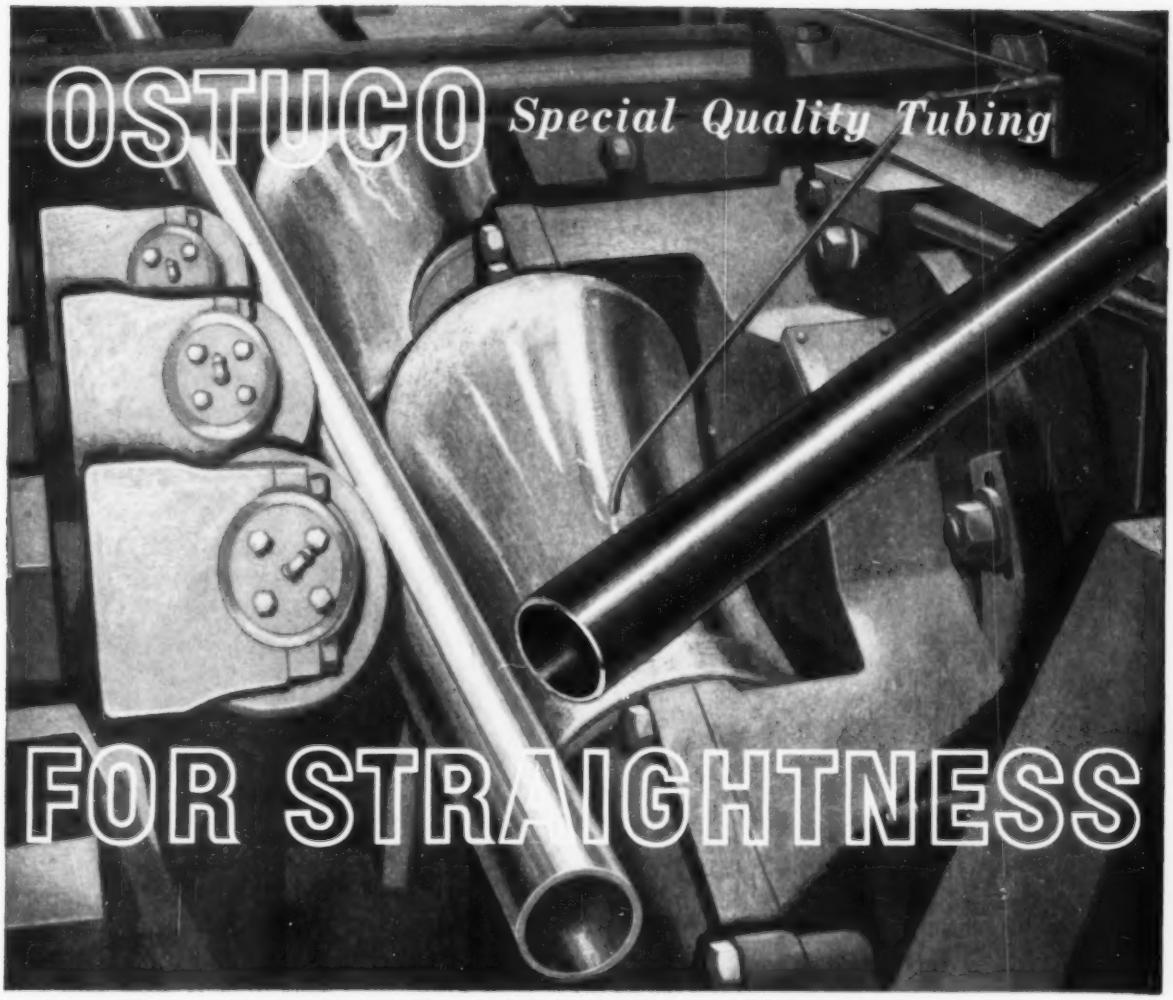
Helicopter Manufacturer Specifies



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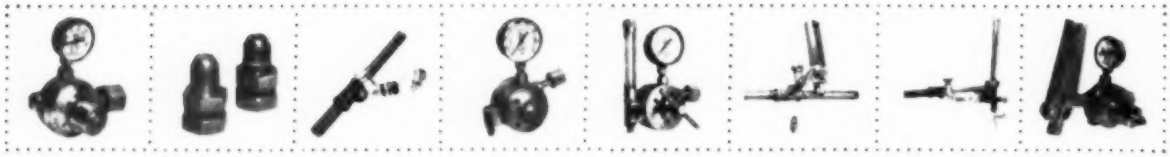

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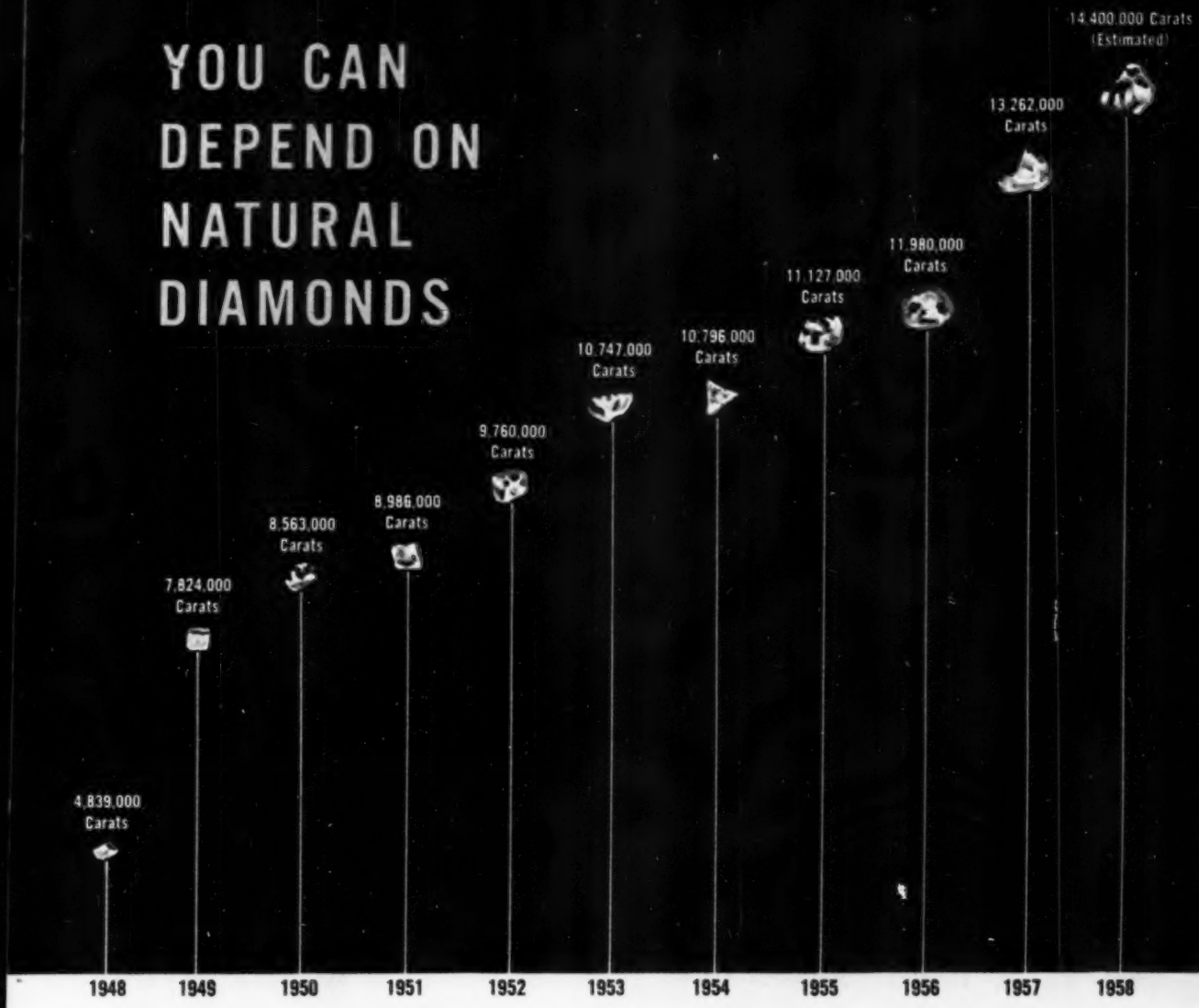

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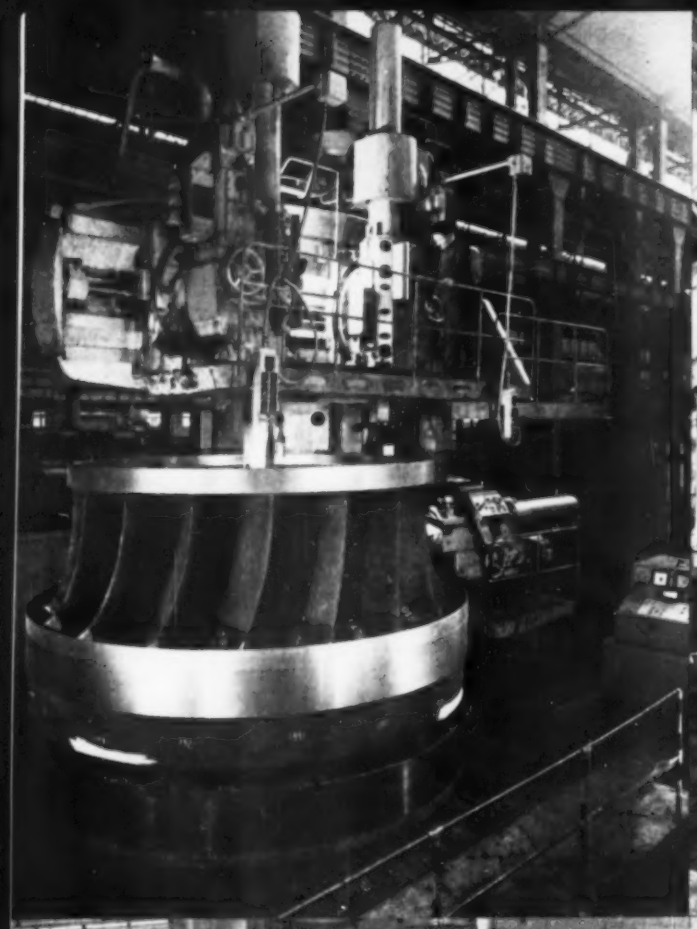

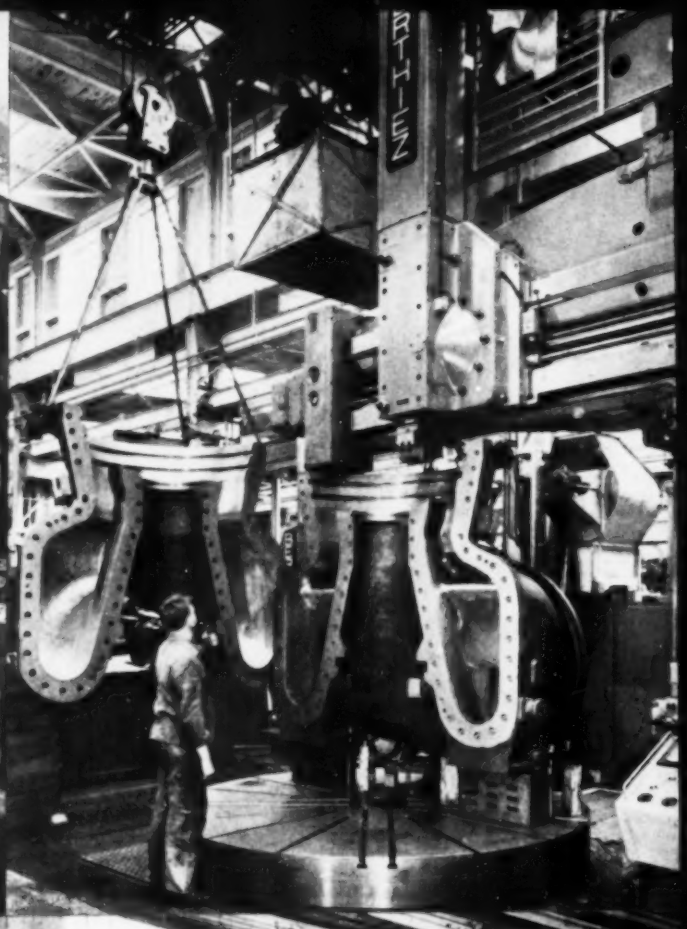

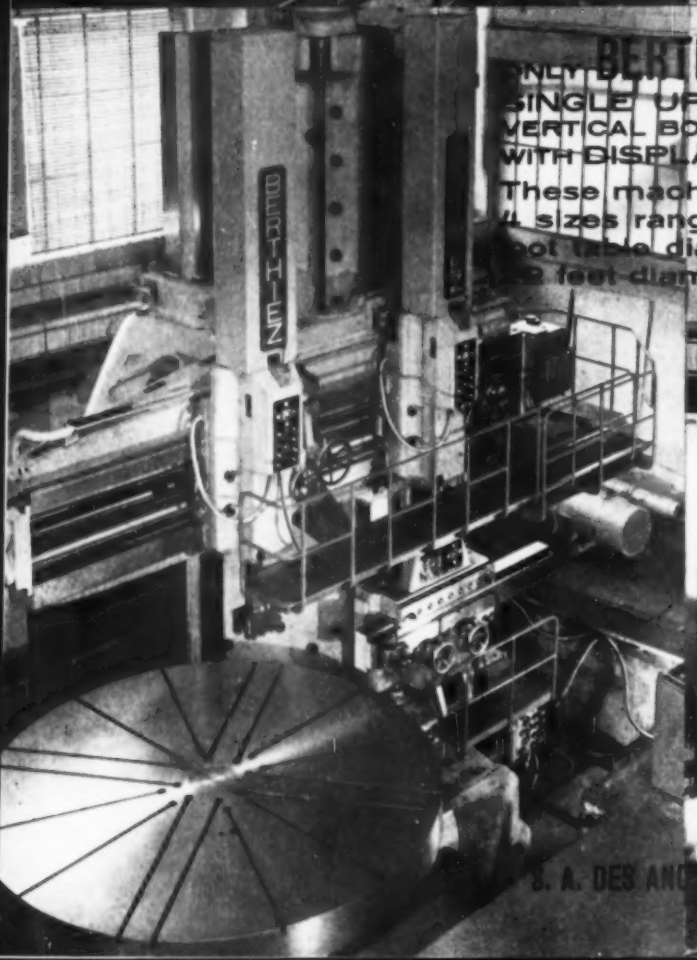

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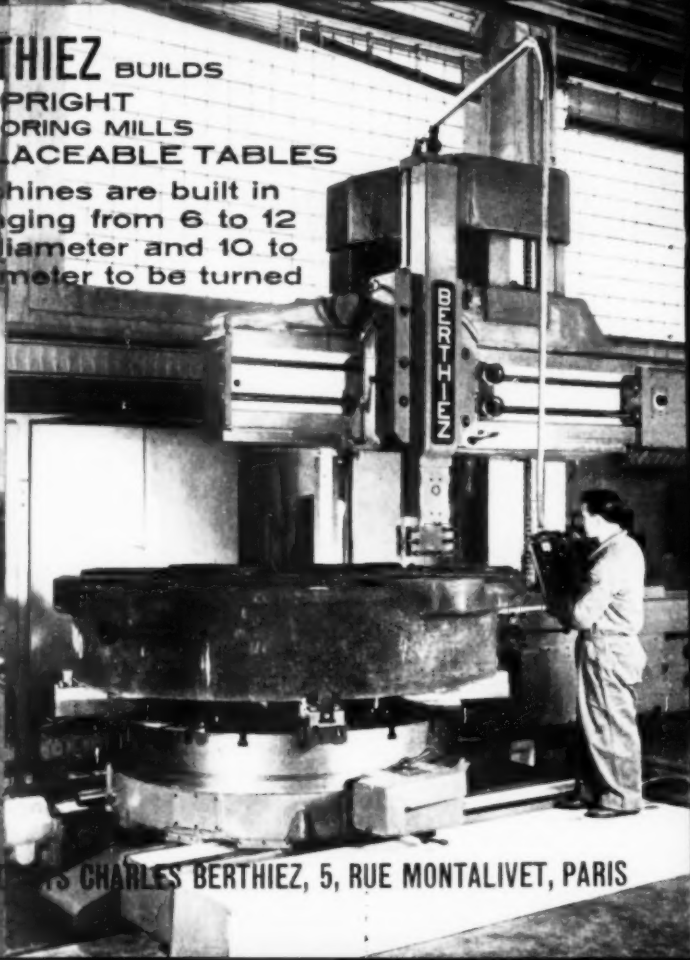

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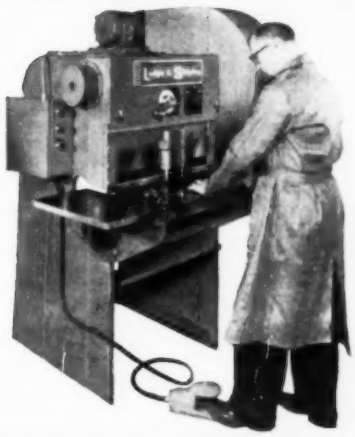

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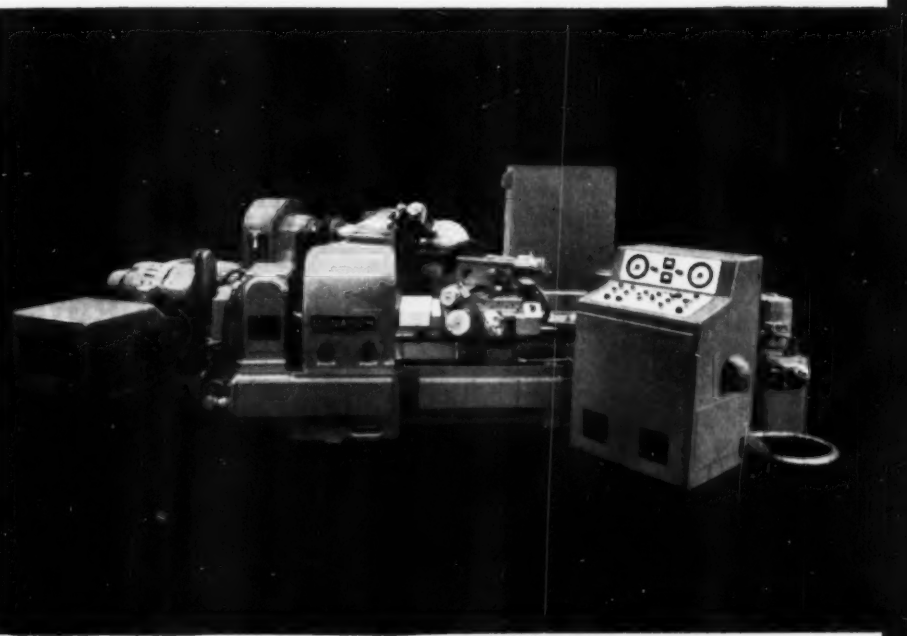

The Series 180 tracer head—an advanced engineering jewel from the Development Laboratories of Monarch.

2..The Series 180 Ultra-Precision Contouring Lathe

Ultra-precision tolerances are brought to a new degree of perfection on this chucking type machine for contouring the O.D. and I.D. of thin-wall spherical and related shape work pieces. From the floor up the Series 180 is new in concept. For example:

1 The Monarch electro-hydraulic tracer has a stylus deflection pressure of only 1½ ounces. This, plus electrical amplification of stylus movement, instantly translates template contour change into hydraulic slide movement.

2 Tracing around a template, the contour is reproduced at the tool within a total accumulated error of ±75 millionths.

3 The constant surface cutting speed drive is separately mounted to eliminate vibration transmittal to the bed.

4 Drive is flexibly coupled to the spindle which is set at a 30° angle to the bed axis. Runout at the spindle nose is less than 20 millionths.

5 Spindle bearing lubricant is refrigerated; the floor-mounted tracer hydraulic tank is separately cooled and coolant temperature is controlled within ±.5°.

6 The machine is built and tested in a temperature controlled area and must be so operated.

The performance characteristics of the Series 180 cannot be equalled by any other lathe. Development of this machine is but another example of the many seemingly impossible turning problems solved by . . . *The Monarch Machine Tool Company*, Sidney, Ohio.

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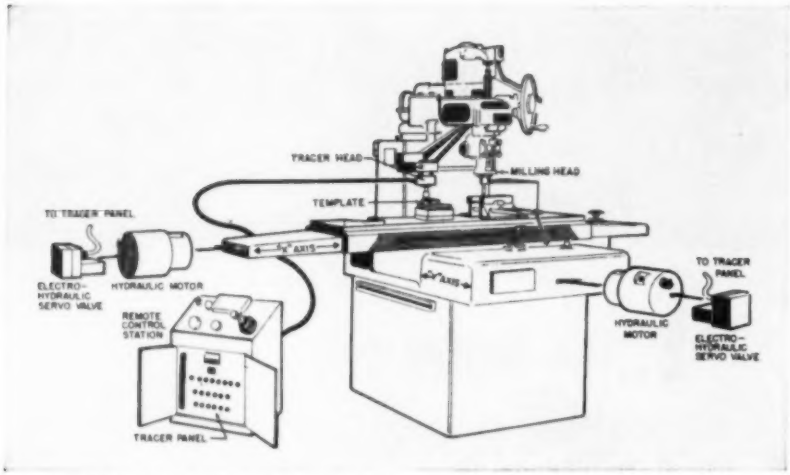

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For further information on Honeywell's new machine control systems and components, and their application to your specific job, call your nearest Honeywell office. Or write: Minneapolis-Honeywell, Department AM-3-12, Minneapolis 8, Minnesota.

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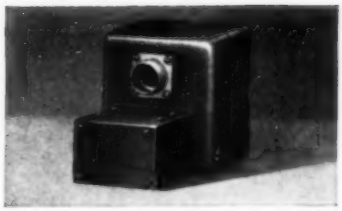
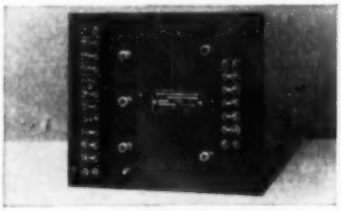


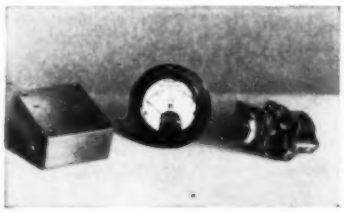
Electro-hydraulic servo valves—2-, 3- and 4-way valves with output flow proportional to input signal. Designed specifically for industrial use.



Transistorized servo amplifiers—proportional and integrating low voltage amplifiers designed for servo systems, incorporating servo valves, d-c relay and servo motors.

Feedback transducers—industrialized linear and rotary transducers providing accurate sensing and feedback for servo loops.

Hydraulic motors—roll-vane motors producing high torques at low speeds. Often connected directly to load. Integral tachometer optional.



Servo accessories—input commands, meters, manifolds, phase conversion panels, consoles, etc., to complement the servo control systems.

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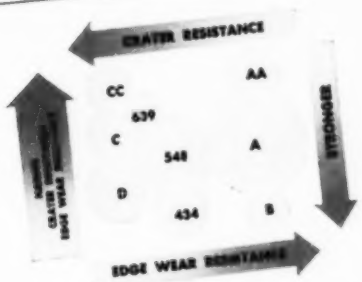
...R GUIDE TO PROPER GRADE SELECTION

MATERIALS

Cast Iron, Copper, Aluminum, Brass, Bronze, Magnesium, Molybdenum, Rubber, Fibre, Masonite, Wood, Plastics, Zinc Alloys, Titanium and Titanium Alloys, Nimonic A, Ni Hard, light cuts on 300 stainless steels. Any material where feed of less than .005 is being used.	SAE 1000, 2000, and 8600 Series.	SAE 3000, 4000 Series SAE 52100, Nitralloy, Monel, Inconel. Heavy cuts on Series 300 Stainless Steels. Series 400 Stainless Steels.
ADAMAS GRADE B, A, AA	**ADAMAS GRADE D, C, CC**	**ADAMAS GRADE 434, 548, 639***
ALSO USED TO MACHINE ANY MATERIAL WHEN EDGE WEAR IS THE PRIMARY PROBLEM.	**ALSO USED TO MACHINE ANY MATERIAL WHEN CRATERING IS THE PRIMARY PROBLEM.**	**ALSO USED TO MACHINE ANY MATERIAL WHEN BOTH EDGE WEAR & CRATERING ARE PROBLEMS.**

* Grade 639 stocked only in throwaways.



EXAMPLES

WHEN MACHINING A MATERIAL WITH GRADE A . . .

- If excessive edge wear occurs change to Grade AA.
- If chipping occurs change to Grade B.
- If cratering is excessive change to a steel cutting grade (probably Grade C).
- If both excessive edge wear and cratering occur switch to Grade 548.

WHEN MACHINING STEEL WITH GRADE C . . .

- If excessive edge wear occurs change to Grade CC.
- If chipping occurs change to Grade D.
- If cratering is excessive change to Grade CC.
- If both excessive edge wear and cratering occur switch to Grade 548.

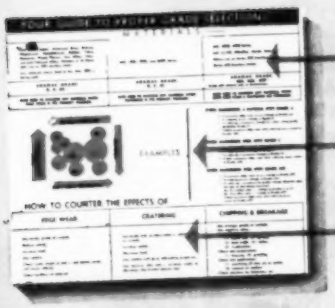
WHEN MACHINING STEEL WITH GRADE 548 . . .

- If excessive edge wear occurs change to Grade 639.
- If chipping occurs change to Grade 434.
- If cratering is excessive the grade change depends upon the type of steel being machined.
  - (a) If a carbon steel — change to Grades C or CC.
  - (b) If an alloy steel — change to Grade 639.
- If both excessive edge wear and cratering occur switch to Grade 639.

HOW TO COUNTER THE EFFECTS OF . . .

EDGE WEAR	CRATERING	CHIPPING & BREAKAGE
Use harder grade of carbide. Reduce speed. Increase feed. Use coolant. Check center height of tool — tool above center will cause rubbing. Check hardness of material.	Use harder and or more crater resistant grade of carbide. Increase speed. Decrease feed. Use coolant with good lubricating properties. Use positive rake tool — increase angle to decrease chip friction against tool.	Use stronger grade of carbide. Use negative rakes. Check tool design: (1) shank size (2) tip size (3) lead angle (4) radius (5) chipbreaker Check tool preparation: (1) brazing (2) grinding Check tool application: (1) overhang (2) tool not on center (3) amount of coolant Check machine for looseness, etc.

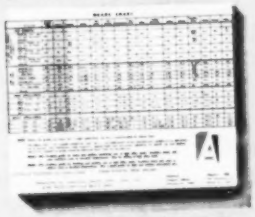
Designed to give you a practical guide to carbide grade selection and application.



Shows what grades to use on a wide range of materials . . . stainless steels, titanium, etc.

Quick reading diagram for fast grade reference.

Valuable application data on how to counter the effects of Edge Wear, Cratering, Chipping and Breakage.



Reverse side carries complete and up-to-date Carbide Industry grade chart (Industry designations C-1 thru C-14).

Ideal for shop posting or desk use . . . size 8" x 10", printed on heavy soil-resistant, high gloss stock.

Send for your Free copy of this chart today.

ADAMAS

CARBIDE CORPORATION
KENILWORTH, NEW JERSEY

Producers of Tungsten Carbide Tools, Tool Tips, Dies, Wear Parts and Dex-A-Tool

CUT OUT AND MAIL

ADAMAS CARBIDE CORPORATION
DEPT. 381 KENILWORTH, NEW JERSEY

Please send me a copy of the new Adamas chart titled ***"Your Guide To Proper Grade Selection"***.

NAME _____ TITLE _____

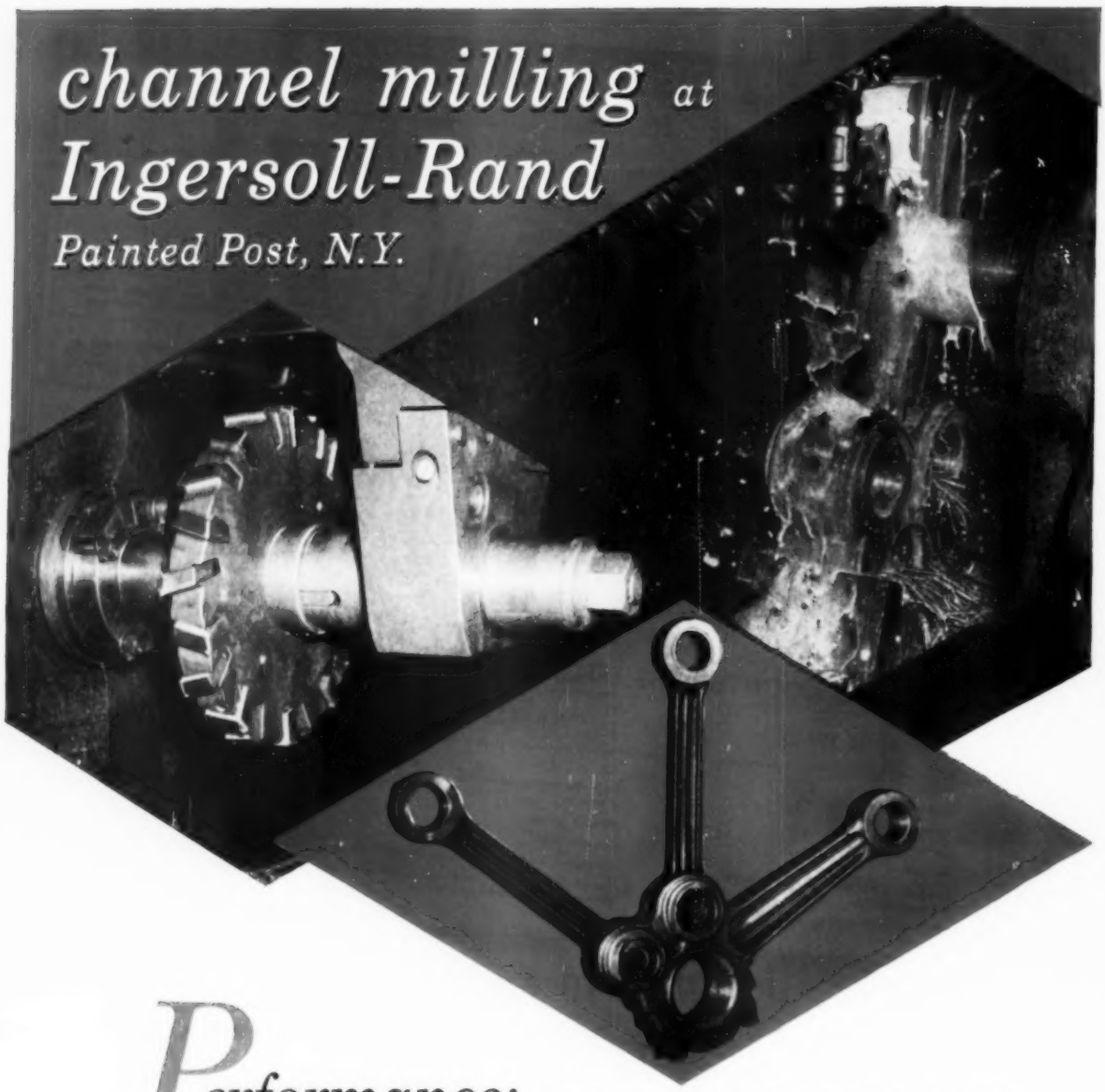
COMPANY _____

STREET _____

CITY _____ STATE _____

channel milling at Ingersoll-Rand

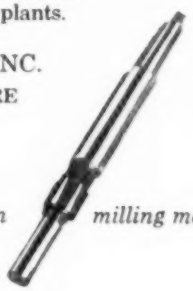
Painted Post, N.Y.



Performance: With one pass, the cutter takes the full depth of 2¾" cut at 15 rpm, 64 surface feet per minute. *Objective and Operation* — Get the metal out in the fastest, cheapest way possible. A job for a modern milling machine. *Workpiece* — Drop forged steel master connecting rods for stationary SVG gas compressors, widely used in oil field work to re-pressure wells, pipelines, and so forth. *Cutting Tool* — A 16-inch O K alternate angle or staggered tooth milling cutter with high speed steel blades set at the correct axial and radial rake to give a shearing action and free chip flow. O K tapered and serrated blades combine maximum strength with ease of replacement and adjustment for wear. ¶ This is just one of hundreds of metal removing operations successfully performed with O K cutters at Ingersoll-Rand plants.

Write for Catalog 13 FREE. THE O K TOOL COMPANY, INC.
400 ELM STREET, MILFORD, NEW HAMPSHIRE

OK *modern milling* *cutters for* *modern milling machines*



Tool Steel Topics

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

Export Distributor: Bethlehem Steel Export Corporation

Lehigh H makes deep draw... passes test with flying colors

It takes a deep draw to form these cone-shaped lamp shades from .025 in. steel sheet at Keystone Lamp Manufacturing Co., Slatington, Pa. The forming die frequently gave trouble, causing production to bog down.

The lamp maker contacted Luria Steel Supply Co., a distributor of Bethlehem tool steel. "We know the job is difficult," they said, "but perhaps you can tell us about a tool steel that will withstand such a deep draw."

The Luria representative had seen such problems before. "I'd recommend Lehigh H," he told them. "I've seen it handle plenty of tough applications. It has all the stamina you need for this job, and then some."

The Lehigh H die, hardened to Rockwell C60, performed just as he said it would. It had high surface hardness to prevent pickup and galling. Because of its high wear-resistance, it averaged 200,000 shades, a substantial increase. Only .010 in. had to be removed when redressing was necessary.

Lehigh H (AISI D-2) is our standard high-carbon, high-chromium grade of air-hardening tool steel. It is a deep-hardening grade with high compressive strength. It has high wear-resistance, plenty of toughness, and minimum size change during heat-treatment — the characteristics you need most for maximum production.

TYPICAL ANALYSIS

Carbon 1.55 Chromium 11.50 Molybdenum 0.80
Manganese 0.40 Vanadium 0.90

The best way to appreciate the advantages of Lehigh H is to put it to work. A trial run in your shop can be arranged by your local Bethlehem tool steel distributor.

BETHLEHEM TOOL STEEL ENGINEER SAYS:

You Can Remedy Fatigue-Failures

Chisels and other tools which are subjected to repeated stresses often fail suddenly. Because these tools are made from shock-resisting steel, the sudden failures can appear mysterious. However, close inspection of the failed parts often reveals that the failures were not sudden at all. They occurred because a crack progressed part way through the section, followed by sudden fracture of the remaining section.

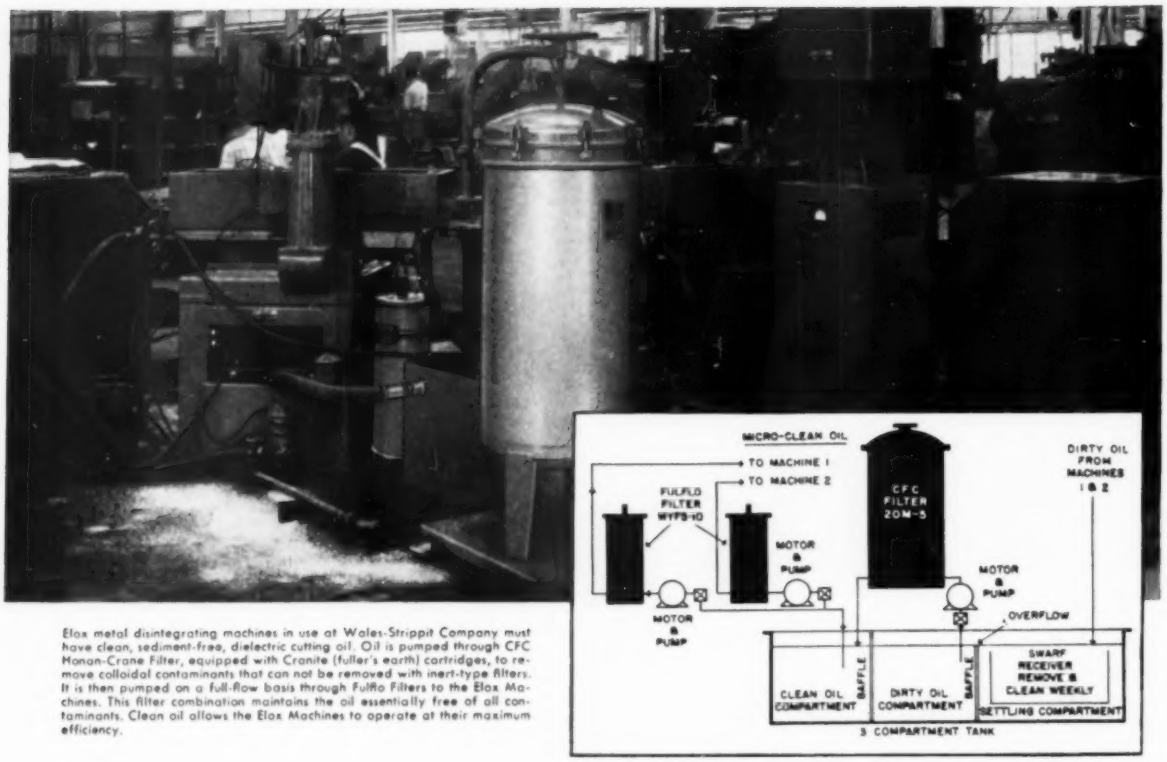
Fatigue-fractures have a characteristic, smooth-rubbed surface where the initial crack opened up, plus an inner crystalline zone revealed by the final sudden break. Often the smooth-rubbed surface shows parallel "oyster-shell" markings, and sometimes, evidence of rusting.

As a rule, fatigue-failures begin at a stress-concentration point, such as a notch, a poor fillet, tool mark, accidental nick, or deep stamping. The proper cure is to correct such design or mechanical faults promptly.

USE UPSET-FORGED DISCS FOR ALUMINUM EXTRUSIONS TOOLING

Bethlehem produces a full line of upset-forged discs for the manufacture of dies for aluminum extrusions. The discs are forged by expert hammer crews. They are finished in ring dies to insure good section. You can choose from two grades of tool steel—Cromo-WV, chrome-moly-tungsten-vanadium (H-12), and Cromo-High V, chrome-moly-high vanadium (H-13). Each grade has good resistance to erosion and heat-checking.

CIRCLE 233 READER SERVICE CARD



Elox metal disintegrating machines in use at Wales-Strippit Company must have clean, sediment-free, dielectric cutting oil. Oil is pumped through CFC Honan-Crane Filter, equipped with Cranite (fuller's earth) cartridges, to remove colloidal contaminants that can not be removed with inert-type filters. It is then pumped on a full-flow basis through Fulflo Filters to the Elox Machines. This filter combination maintains the oil essentially free of all contaminants. Clean oil allows the Elox Machines to operate at their maximum efficiency.

WALES-STRIPPIT gains 2 production hours per day—per machine—with *Fulflo* and *CFC* Filters

Here's how Wales-Strippit Company solved the problem of costly downtime — and also assured superior quality of holes cut with Elox Disintegrating machines. First, they switched to CFC Honan-Crane Multi-Cartridge Filters with Cranite (fuller's earth) elements. This removes both solid and dissolved impurities to assure micro-clarity. Oil is then fed to the electrode area through Fulflo Filters, with Honeycomb Filter Tubes, to remove any micro-contaminants that may have entered the system after the initial filtration.

Result? Downtime to change filter elements for each machine was reduced from 20 minutes every 3 to 4 hours — to 20 minutes once each week. This saving in downtime permits an extra 2 hours of productive time per machine, per day (for three 8-hour shifts). In addition, micro-clarity of the oil prevents any nicks in the cut surface and enables the machines to hold close tolerances between the electrodes and work areas.

Fulflo Filters provide true depth filtration to any degree of micro-clarity for all types of industrial fluids — oils, liquid fuels, liquid chemicals, compressed air, CO_2 and other gases; for high or low flow rate, pressure, *p*H, temperature, or viscosity. CFC Honan-Crane Filters are designed for bypass application, coolant clarification, magnetic separation, and many other uses.

Send for technical literature or engineering assistance to Department

COMMERCIAL FILTERS CORPORATION
MELROSE 76, MASSACHUSETTS
PLANTS IN MELROSE, MASSACHUSETTS AND LEBANON, INDIANA

MICRO-CLARITY AT MINIMUM COST

Fulflo FILTERS — *with genuine Honeycomb Filter Tubes for controlled micro-clarity of industrial fluids.*

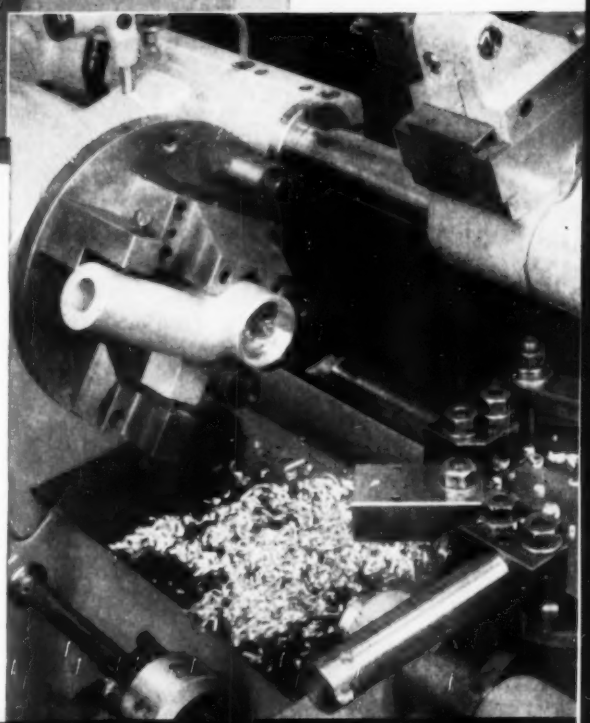
CFC FILTERS — *Selective filtration of oils • water-oil separators • magnetic separators • pre-coat filters • coolant clarifiers • automatic tubular conveyors.*

HARDINGE
ELMIRA, N.Y.

PRECISION CHUCKING MACHINE

Users say:

"We now get Production with Tool Room Accuracy"



Users enthusiastically tell us how they can easily maintain close tolerances, get better parts finish, and at the same time substantially cut costs . . . when they put Hardinge High Speed Precision Chucking Machines to work.

These results are possible because parts are finished in one setting with simplified tooling. All parts shown were produced with standard tool bits.

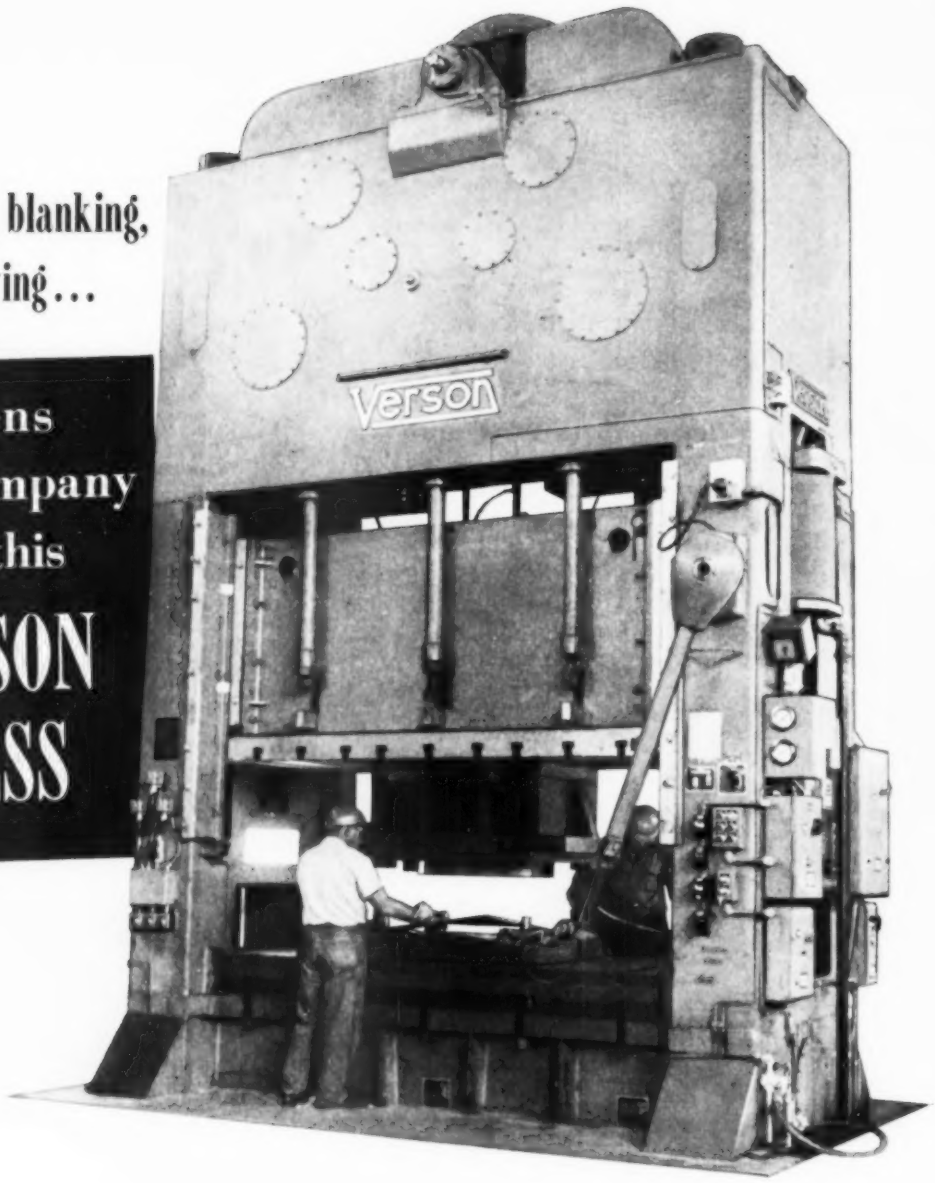
1 1/16" Collet Capacity— 6" Chucking Capacity— Write today for Bulletin HC-HCT which presents the whole story.

HARDINGE BROTHERS, INC., ELMIRA, N. Y.

PERFORMANCE HAS ESTABLISHED LEADERSHIP FOR HARDINGE

For punching, blanking, forming, drawing...

Lukens Steel Company uses this VERSON PRESS



Here's another example of the versatility of Verson Presses. This 600 ton eccentric, installed at Lukens Steel Company, Coatesville, Pennsylvania, performs a wide variety of work. Punching . . . blanking . . . forming . . . drawing . . . the Verson Press handles them all.

This machine has a 14" stroke with 10" power adjustment of the slide. Area of the slide and bolster is 54" x 108". The press operates at 14 SPM and has a drawing speed of 51 FPM. A Verson Cascade lubrication system automatically supplies oil to all lubrication points on the press. Should a lubrication failure occur, the press is stopped automatically.

Big job . . . small job . . . there is a Verson Press to meet your needs. When requirements call for great versatility . . . men who know presses . . . depend upon Verson. Whatever your requirements, it will pay you to talk to Verson first.

A Verson Press for every job from 60 tons up.

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Verson

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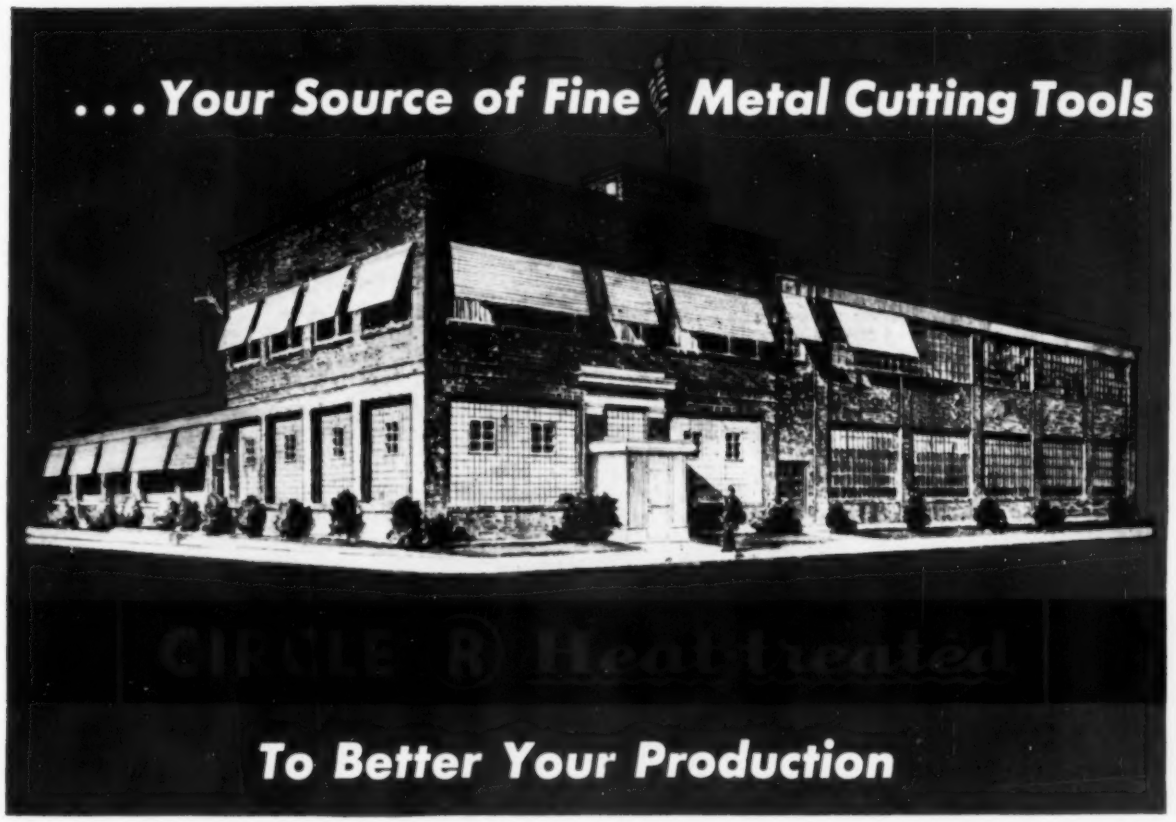

To Better Your Production

CIRCLE R Circular Metal Cutting Tools are designed and crafted in this plant, one of the largest anywhere devoted exclusively to this specialty. Our extensive facilities — 45,000 square feet — allow for every refinement in production of fine tools, holding within very precise tolerances where required.

SCIENTIFIC HEAT TREATING is one of our specialties. We use the latest and best obtainable furnaces, with automatic controls. Much of the specialized equipment is our own exclusive design, developed to implement our innovations in heat treating methods.

PRECISION CONTROL governs our quality and cost through the finest gauging and other equipment, under constant supervision. Profilometer indicates surface finish variations in micro-inches. Magnaglo inspection rules out rejects before they reach costly finishing stages — for you, virtually does away with down time due to cutting tool defects.

SPECIAL TOOLS are regularly developed to meet your specific needs with efficiency and economy for the widest variety of materials and cutting and slitting operations.

STANDARD PRODUCTS meet your needs in the complete range of slitting saws for metal, copper, textile metallics, plastics, rubber, sandpaper, emery cloth, etc.; cut off saws, commutator slotting saws, jewelers slotting saws; circular knives and rotary shear blades; Deep-Cut saws, Circoloy steel saws, HSS saws, solid and tipped tungsten carbide saws, combined drills and countersinks and center reamers.

CIRCLE R REPRESENTATIVES are at your service in all key markets — specialists in metal cutting, whose advice to you is backed by Factory Consultation Service developed through continuous research and experience since 1923.

Consult these CIRCLE R *Specialists . . .*

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Specialists in Circular Cutting Tools Since 1923

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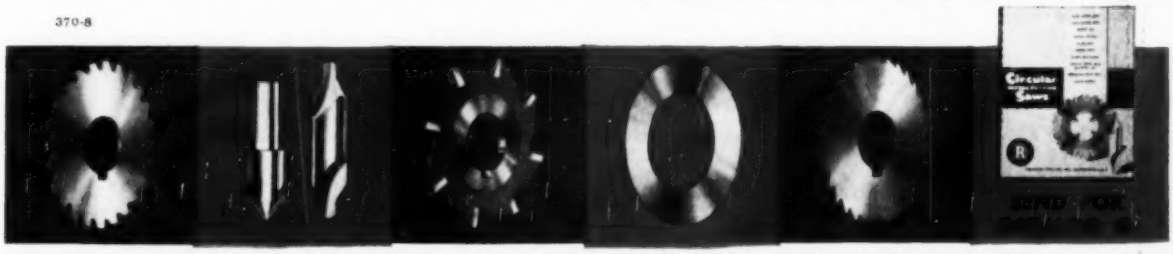

METAL SLITTING SAWS • COPPER SLITTING SAWS • SCREW SLOTTING SAWS • COMMUTATOR SLOTTING SAWS • JEWELERS' SLOTTING SAWS • CUT OFF SAWS • CIRCULAR KNIVES & ROTARY SHEAR BLADES • CIRCOLOY STEEL SAWS • SOLID & TIPPED TUNGSTEN CARBIDE SAWS • COMBINED DRILLS & COUNTERSINKS • CENTER REAMERS

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Look at the proven performance:

FIELD TEST #1
Midwest Manufacturer of Tapping Units
Part: Aluminum grommet drilled to a depth of ½"
Operation: Tapping ⅜" deep
Production: 70 pieces/minute
Result: 18,000 holes tapped with one #10-24 "Turbo-Cut" Tap and *still usable.*

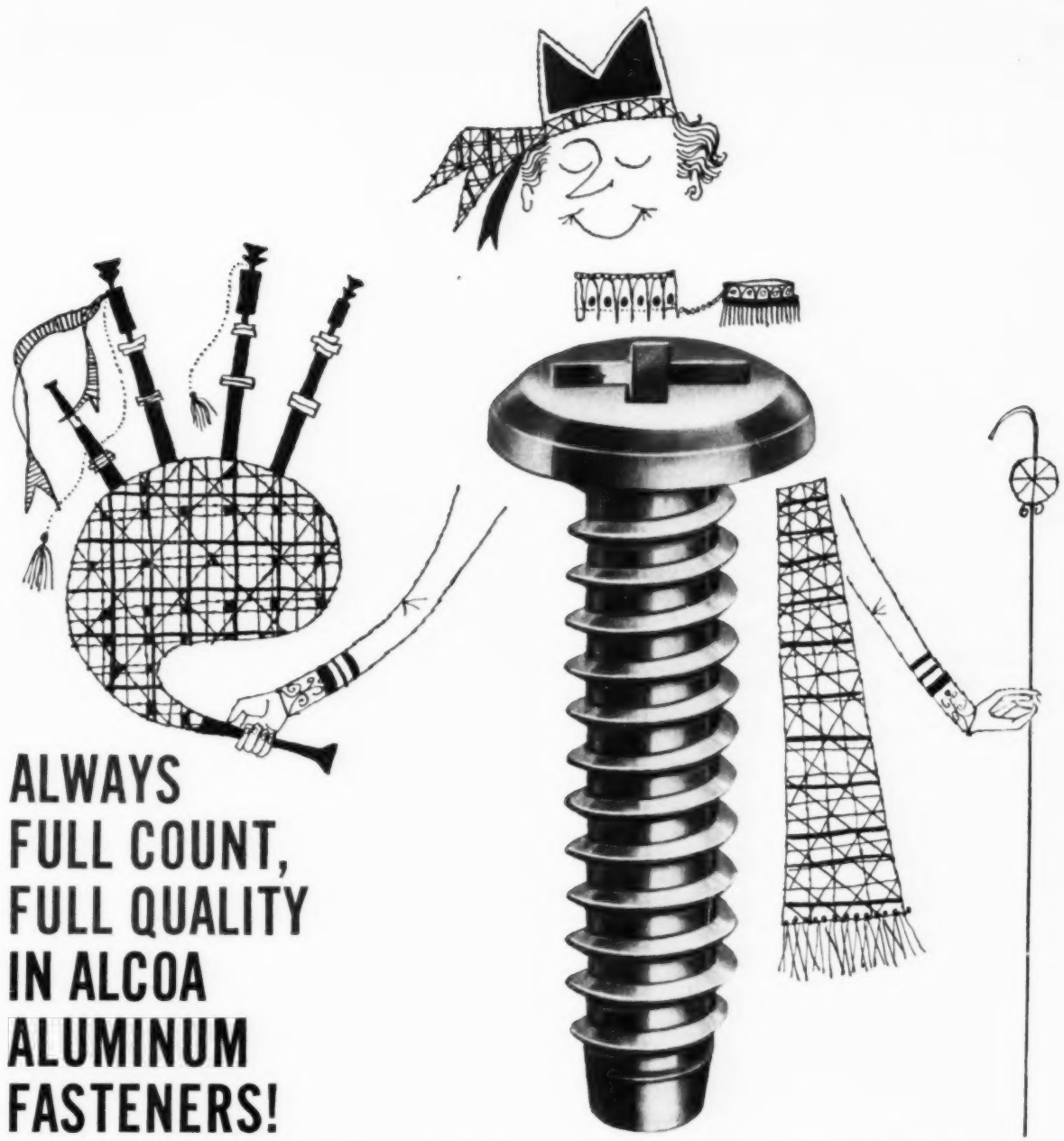
FIELD TEST #2
New England Manufacturer of Plumbing Fixtures
Part: Polystyrene bathroom accessory
Operation: Tapping
Production: 50,000 holes tapped with one ¼-20 "Turbo-Cut" Tap and *still usable.*

This is not a misprint.

See your Threadwell Distributor for complete details or write direct to:

Threadwell

THREADWELL TAP & DIE COMPANY Greenfield, Mass., U.S.A.



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YOU'LL FIND 144 or more *perfect* fasteners in *every* gross box when you order from your local Alcoa Distributor. On bulk items, too, you'll receive the number of pieces ordered. And there'll be no rejects, no misfits, no "seconds" . . . whether you buy a hatful or a carload!

And, of course, Alcoa® Aluminum Fasteners give you maximum protection against corrosion. Their bright, flawless finish adds extra sales appeal to your product at the time of purchase—and won't stain or mar it at any time *after* purchase.

Your Alcoa Distributor carries *complete* stocks of all standard types and sizes, locally—for really prompt filling of your orders. You'll find him in the Yellow Pages of your phone book. Why not give him a call right now? Or, if you'd like additional facts and a few samples, just mail the coupon!

Your Guide to the Best in Aluminum Value

ALCOA ALUMINUM

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FREE . . . FACTS, SAMPLES FREE . . . FACTS

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Gentlemen: Please send complete specification data and samples of Alcoa Aluminum Fasteners.

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Here's a MARVEL HIGH-SPEED-EDGE Hack Saw Blade we wouldn't sell you!

This blade **could** have been packaged and shipped as a genuine MARVEL High-Speed-Edge Blade . . . and it **might** have performed to a customer's satisfaction. Instead, it was rejected and will be scrapped because inspection revealed a minute imperfection.

There's nothing unusual about this. Certainly, other hack saw blade manufacturers inspect their products, and undoubtedly reject blades for one reason or other, because they are trying to market the best blades they know how to make.

And that's the point—here at MARVEL, where the composite blade was invented and perfected over 30 years ago, we believe we know more about making high-speed-edge hack saw blades than any other maker. We've been at it longer, and the unequalled performance of MARVEL Blades on every kind of material is evidence that we're right.

Use MARVEL Blades on your power hack saws with perfect confidence that they have no equal. You can get MARVEL Blades at your nearby Industrial Distributor.

Write for the new MARVEL Cutting Tool Bulletin.

B-1124

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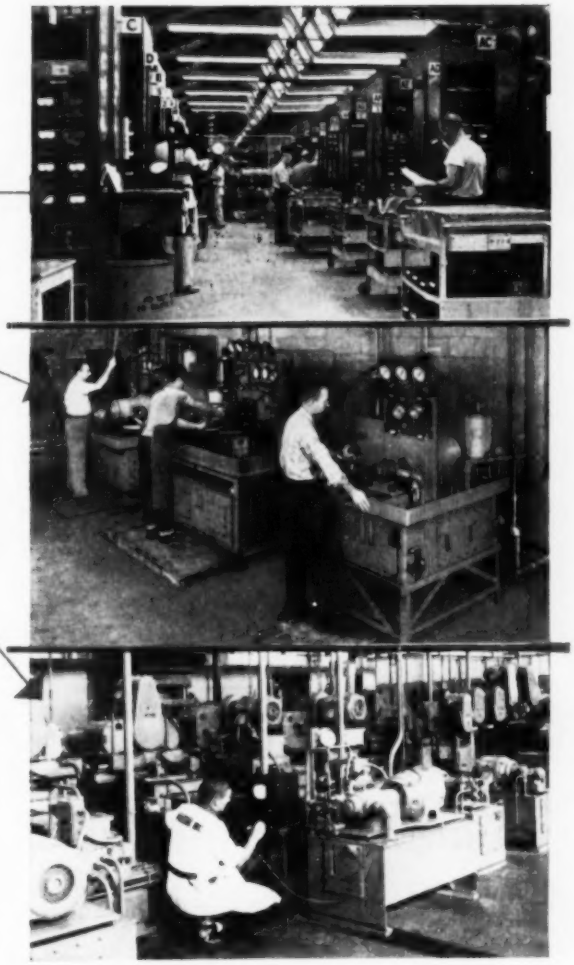

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- **Repair or exchange of Units**—promptly—tested to factory specifications
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- **Field service**—other Field Service Headquarters locations listed below (underlined)

*Applies to standard Industrial line products and selective Mobile products—Aircraft products are not included.

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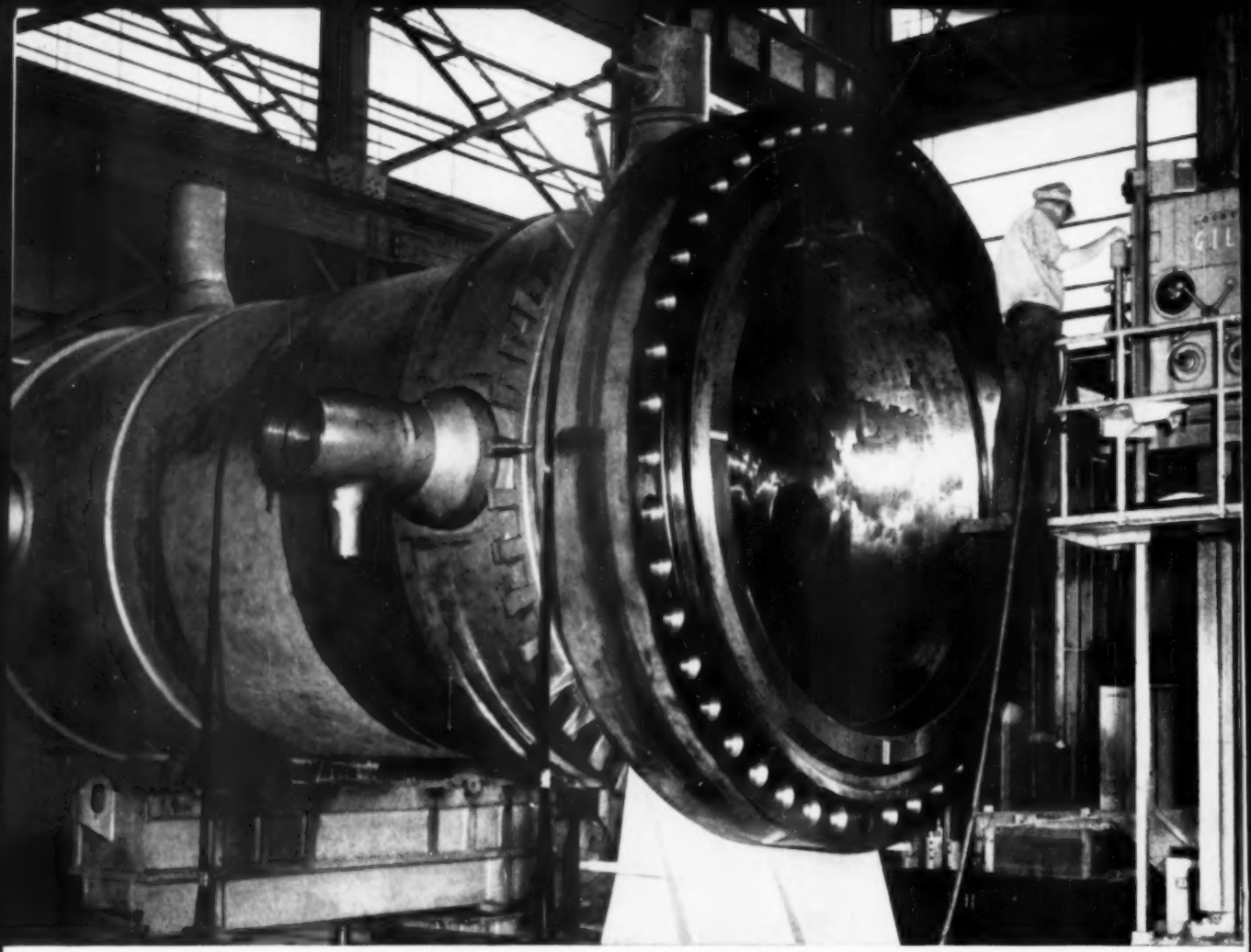
ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

CIRCLE 241 READER SERVICE CARD



Courtesy Combustion Engineering, Inc.

Combustion Engineering specified more than "ordinary boring mills"

Combustion Engineering, Inc., pioneer manufacturer of heavy reactor vessels, concluded that ordinary boring mills would not produce the close tolerances and surface finish required in their critical operations. That is why they specified a Cincinnati Gilbert floor type boring mill for this job.

The workpiece is a 96-ton stainless steel reactor for a Naval nuclear power plant. The Gilbert machine is used to finish the boring of the bolt holes in the 20" thick flange, and to machine the outlet nozzles.

Combustion Engineering's high standards require a surface finish of 32 R.M.S. on some of the bolt holes—an easy specification for a Gilbert, which can bore holes with a mirror finish, when required. A Tele-Vernier optical measuring system increases the speed and accuracy of machine positioning.

Work of equally high quality is produced on a number of other Gilbert boring mills at Combustion Engineering's Chattanooga and Windsor plants—proof that "those who buy Gilbert buy Gilbert again."

Write for new Bulletin 558.

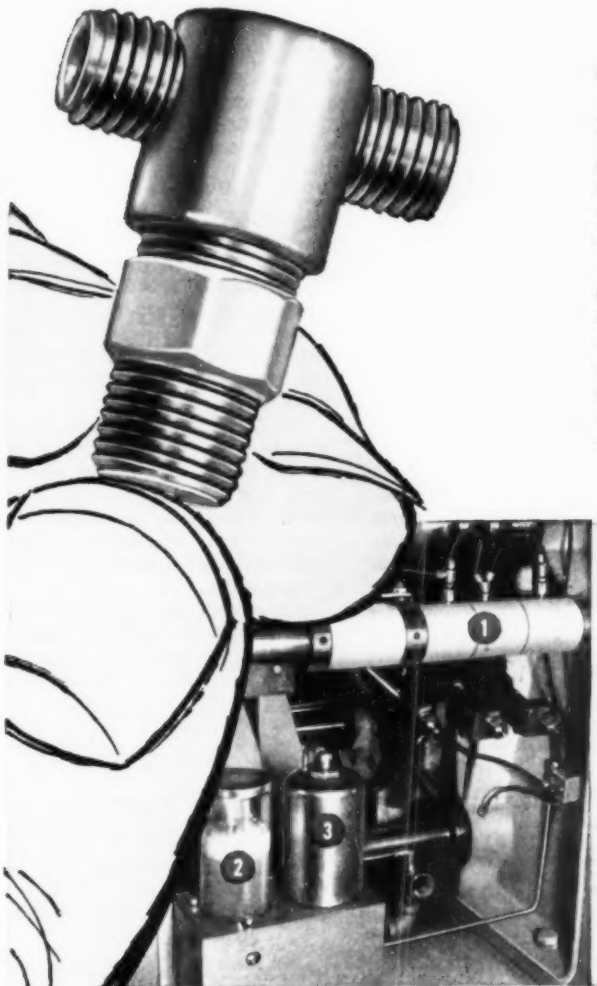
The Cincinnati Gilbert Machine Tool Co., 3340 Beekman Street, Cincinnati 23, Ohio.

those who buy **GILBERT** *buy Gilbert again*

CIRCLE 242 READER SERVICE CARD

ACCUMITE® BY ALEMITE

...TO GIVE ANY MACHINE ALL THE ADVANTAGES OF CENTRALIZED LUBRICATION...AT LOW COST!



Accumite lubricates 24 points of spring winding machine. 1. Valves mounted directly on bearings. 2. Transparent lubricant reservoir. 3. Manually controlled air pump, actuated by "push-pull" valve.

Engineered for limited space, outperforms many higher-priced systems!

Alemite—with more than 40 years of centralized lubrication experience—announces an all-new compact system complete with pump, metering valves and controls—especially designed to service many machines and vehicles where centralized lubrication has been impractical until now!

Alemite's new compact Accumite system is especially adaptable to light, precision, multiple-bearing machines that have limited installation space. Its small size and simple installation overcomes cost limitations in most plants. Typical applications are: packaging, canning, labeling and textile machines...and machine tools. It is also suitable for tractor trailers, lift trucks and farm implements.

ACCURATELY METERS THESE SHOTS OF OIL OR GREASE

.003 cu. in. .006 cu. in. .009 cu. in.

ALL THE ADVANTAGES OF "BUILT-IN" MEASURED LUBRICATION—PLUS COMPACT SIZE!

- Meters exact amounts of refinery-clean lubricants to all bearings whenever system is operated.
- Eliminates shutdown time for lubrication.
- Seals lubricant against dirt, grit and water.
- Prevents bearing troubles due to neglect or use of wrong lubricants.
- Services all bearings in one operation.
- Avoids work spoilage and bearing repairs due to overlubrication.

Mail coupon for full information!

ALEMITE, Dept. F-39
1850 Diversey Parkway, Chicago 14, Ill.

Please send me all the facts about your new "Miniature" Accumite system.

Name_____

Company_____

Address_____

City_____ Zone____ State_____

Symbol of SW Excellence

ALEMITE DIVISION
STEWART-WARNER CORPORATION

1850 Diversey Parkway, Chicago 14, Ill.

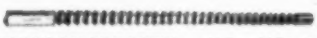
Cut a
KEYWAY
for
ONE CENT

Minute Man
KEYWAY BROACH KIT

In one minute and for as little as one cent you can cut a keyway with the Minute Man Keyway Broach Kit. For keyways from 1/16" to 1" in any bore from 1/4" to 3".

SAVE MONEY WITH
THESE OTHER STANDARD
STOCK BROACHES

SQUARE BROACHES — 1/8" to 3/4" holes



HEXAGON BROACHES — 1/8" to 3/4" holes

ROUND BROACHES — 1/4" to 1" holes

SEND FOR CATALOG
AND PRICE LIST

The duMont Corp.
Greenfield, Mass.

MAIL FREE BROACH CATALOG AND PRICE LIST A describing Square Broaches, Hexagon Broaches, Production Type Keyway Broaches and Keyway Broach Kits to

Name

Company

Address

duMont

Letters...

To American Machinist
330 W 42nd St, NY 36, NY

T-slot standards

Dear Sirs:
I read with interest your article concerning the convertibility of European currency to dollars and our machine tool exports (*AM*—Jan 12 '59, p10).

It is common knowledge that Communist countries are charging Europeans $12,000 for a jig boring machine which would cost $40,000 if purchased from the US. In fact, the Communists could give the machine away in order to take the business away from the US, because they have to account to only the Communist Party which owns all material and all labor. Therefore, anything we do to help the Communist movement improve their machine tools is promoting the destruction of our country and our form of free government.

Knowledge of this was instrumental in causing the Standards Committee of Saginaw Valley Chapter of the American Society of Tool Engineers to resign en masse this January when they learned their T-slot spacing work might be channeled through the ASTE to the International Organization for Standardization (ISO). The Committee members believe that they would be grossly negligent with respect to the preservation of their country and the fulfillment of their Society's Code of Ethics if they were a party to furnishing such technical knowledge directly or indirectly to any ISO agent of the USSR or its satellites.

C E Bierwirth
Flint, Mich

This provocative letter has been published in full. Here is some background information on the circumstances. We conclude with our opinion. Further letters on this controversial subject will be welcomed.

The ISO is an organization that coordinates standards activities among the 38 nations that participate, just as the American Standards Association coordinates the work of the many technical societies and trade associations in the United States.

T-slot sizes were first standardized in the US in 1927. An attempt is now being made to resolve the

SHOPMATES

N. Jarvis

LOAN THE KID THE TOOLS HE NEEDS — YOU HAD TO START ONCE — DIDN'T ANYBODY GIVE YOU A HELPIN' HAND WHEN YOU WAS YOUNG?? OPEN YER HEART AND YER TOOL BOX!! HELP THIS BOY!!
MY PENCIL!!
WHERE D'YA GET THAT OLD STUFF — BORROWIN' ALL THE TIME?? NO SELF RESPECT!! YOU EARN A PAY — BUY YER OWN — HARD TO REPLACE — ETC — ETC — BLA — BLA!!
N. JARVIS

EXTRA DRILLING CAPACITY FOR YOUR TOOLROOM

LELAND-GIFFORD NO. 3 MVB TOOLROOM DRILL PRESS

A companion machine to the widely used Leland-Gifford No. 2 LMS Toolroom Drill Press — providing extra capacity with comparable features and conveniences. This machine is always available to help with heavy-duty production work while handling the general run of toolroom drilling and tapping with effortless speed and ease.

✓ *check these features*

- √ Speeds from 33 to 1,800 RPM.
- √ Capacity of No. 3 Morse Taper.
- √ Extra large 40½″ x 23½″ or standard 24½″ x 23½″ tee-slotted table.
- √ 24″ swing with 12″ overhang. Geared power feed with feed rates of .006″ — .012″ — .018″ per revolution.
- √ Illuminated indicating shift with cutting speed chart.
- √ Conveniently located hand wheel for changing spindle speeds and shifting back gears without stopping machine.
- √ Positive stop for accurate depth adjustment.
- √ Foot switch start-stop motor control.
- √ Counterbalanced sliding head.
- √ Built-in light for table and work illumination.

Write for complete information.

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Drilling Machines

WORCESTER 1, MASSACHUSETTS, U. S. A.

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LOS ANGELES
2620 Leonis Blvd., Vernon 58, Cal.

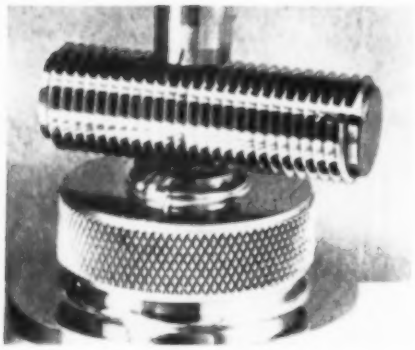
NEW YORK
75 S. Orange Ave., South Orange, N. J.

ROCHESTER 12
P. O. Box 24, Charlotte Station

WHY YOU NEED

VK CALIBRATED THREAD WIRES

59th YEAR



VAN KEUREN STANDARD 60° THREAD MEASURING WIRES ARE NOW CALIBRATED TO WITHIN .000005" OF EXACT SIZE AT NO EXTRA COST.

THIS PREVENTS THE LOSS OF SUBSTANTIAL PORTIONS OF YOUR PITCH DIAMETER TOLERANCES.

CONSIDER

With VK *Calibrated* Wires:
Maximum deviation in wire size as shown on label = .000005"

Maximum error in measurement of 60° Threads due to wire deviation
= .000005" x 3*
= .000015"

For a 3/8-24, Class W, Thread Gage the pitch diameter tolerance is .0001". Thus maximum measurement error using *calibrated* wires is 15% of pitch diameter tolerance.

With *Uncalibrated* Wires:
Maximum deviation in wire size as shown on label = .000025"

Maximum error in measurement due to wire deviation
= .000025" x 3*
= .000075"

Note here that the error in measured pitch diameter using *uncalibrated* wires could be 75% of the total tolerance allowed for the pitch diameter of the 3/8-24, Class W, Thread.

*Change in Measurement for 60° threads = Change in Wire Diameter x (1 + cosec 30°)

CAN YOU AFFORD TO GAMBLE PART OF YOUR PITCH DIAMETER TOLERANCE ON UNCERTAINTY AS TO THE TRUE DIAMETER OF THE MEASURING WIRES?

Wouldn't it be a good idea to send us your uncalibrated or worn thread measuring wires for calibration and replacement where necessary? Liberal allowance will be made on uncalibrated wires toward the purchase of new calibrated wires.

VK THE Van Keuren CO.
173 WALTHAM STREET, WATERTOWN, MASS.
Optical Flats . . . Light Wave Equipment . . . Light Wave Micrometers . . . Gage Blocks . . . Wire Type, Taperlock and Trilock Plug Gages . . . Master Setting Disks . . . Thread Measuring Wires . . . Gear Measuring Wires . . . Carbide Plug Gages . . . Carbide Parts . . . Precision Lapping Service.

conflicts between the various national standards in an ISO standard of sizes.

There have been proposals in the US, notably by auto firms, that T-slot spacing be standardized. (AM—Mar 11 '57, p162). We know of no plans to develop an international spacing standard.

In this country, T-slot standards are the responsibility of the "B.5 Activity". This is a committee administered by ASME with many representatives from technical societies, trade associations, and private industry.

We believe in standards activity, but we believe that standards must be developed through agreement and compromise. No committee or organization can establish a standard by decree, it can only be done by use. We suspect that the United States has suffered in the past from taking too little part in international standards activity at the working level, with the result that our needs and our wishes have not always been made clear. Recent efforts have been made to improve our situation and many people have given much of their spare time to efforts to establish improved liaison and promote the US point-of-view.

Finally, we believe there is nothing secret about a proposed standard. By its nature, such a proposal must receive wide circulation so that many people can study it, criticize it, and seek to revise it. From these comments grows a tentative standard. If people then use it, it becomes a real standard—Ed.

"I don't know how I'm getting along with the brass, nobody's spoken to me in the last five months."

CALENDAR

American Society for Metals — Western Metal Exposition and Congress, Mar 16-20, Pan-Pacific Auditorium and Ambassador Hotel, Los Angeles, Calif.

American Machine Tool Distributors Association—Spring Meeting, Mar 17-19, Sheraton, Park Hotel, Washington, DC.

Investment Casting Institute—Annual Meeting, Mar 17-19, Santa Monica, Calif.

Society of Automotive Engineers —National Production Meeting, Mar 19-20, Sheraton-Cadillac Hotel, Detroit, Mich.

Society of Automotive Engineers —National Aeronautic Meeting, Production Forum, and Display, Mar 31-Apr. 3, Hotel Commodore, New York, NY.

American Welding Society—Annual Meeting and Exposition, Apr 6-10, Sherman Hotel and International Amphitheatre, Chicago, Ill.

American Foundrymen's Society—Engineered Castings Show, Apr 13-17, Sherman and Morrison Hotels, Chicago, Ill.

Armour Research Foundation and Institute of Radio Engineers—Conference on Industrial Instrumentation and Control, Apr 14-15, Illinois Institute of Technology, Chicago, Ill.

American Society of Tool Engineers—Annual Meeting, Apr 18-22, Schroeder Hotel, Milwaukee, Wis.

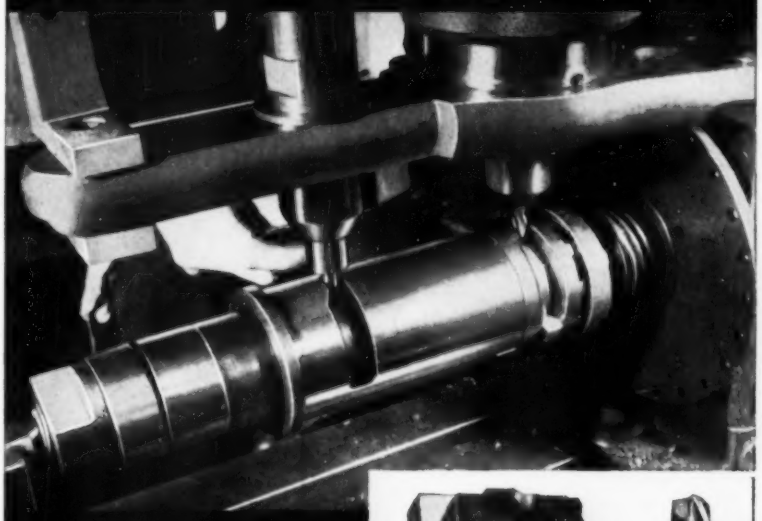
Metal Powder Industries Federation—Annual Meeting and Powder Metallurgy Show, Apr 20-22, Sheraton-Cadillac Hotel, Detroit, Mich.

Metal Treating Institute—Spring Meeting, Apr 23-25, Hollywood Beach Hotel, Hollywood, Fla.

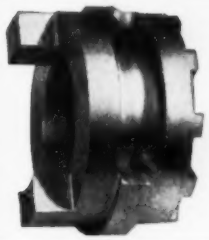
Nation Screw Machine Products Association — Annual Meeting, Apr 26-30, Roosevelt Hotel, New York, NY.

Grinding Wheel Institute & Abrasive Grain Association — Semi-Annual Meeting, Apr. 27-29, The Homestead, Hot Springs, Va.

'Standard' off-the-shelf End Mill



Speeds Production, Speeds Delivery of Machine Tool Clutch!



Machine tool clutch showing cam track milled with "Standard" Brown & Sharpe End Mill.

½" "Standard" Brown & Sharpe High Speed double-end End Mill.

One of the 72, yes *seventy-two*, different Brown & Sharpe ½" End Mills that cut production days and add dollars of production profits to this job.

Operation: On tracer-controlled milling machine—plunge cut and peripheral mill a cam track contour in special, extra tough alloy steel machine tool clutch.

Choose the correct Brown & Sharpe End Mill from the World's Largest Stock of "Standards" and start production.

Eliminate days of waiting for special tools—eliminate trial and error of unproved tools—with Brown & Sharpe PRODUCTIONEERED CUTTERS!

Send for Catalog showing more than 3400 "Standard" Brown & Sharpe Milling Cutters to: *Cutting Tool Division, Brown & Sharpe Manufacturing Company, Providence 1, Rhode Island.*

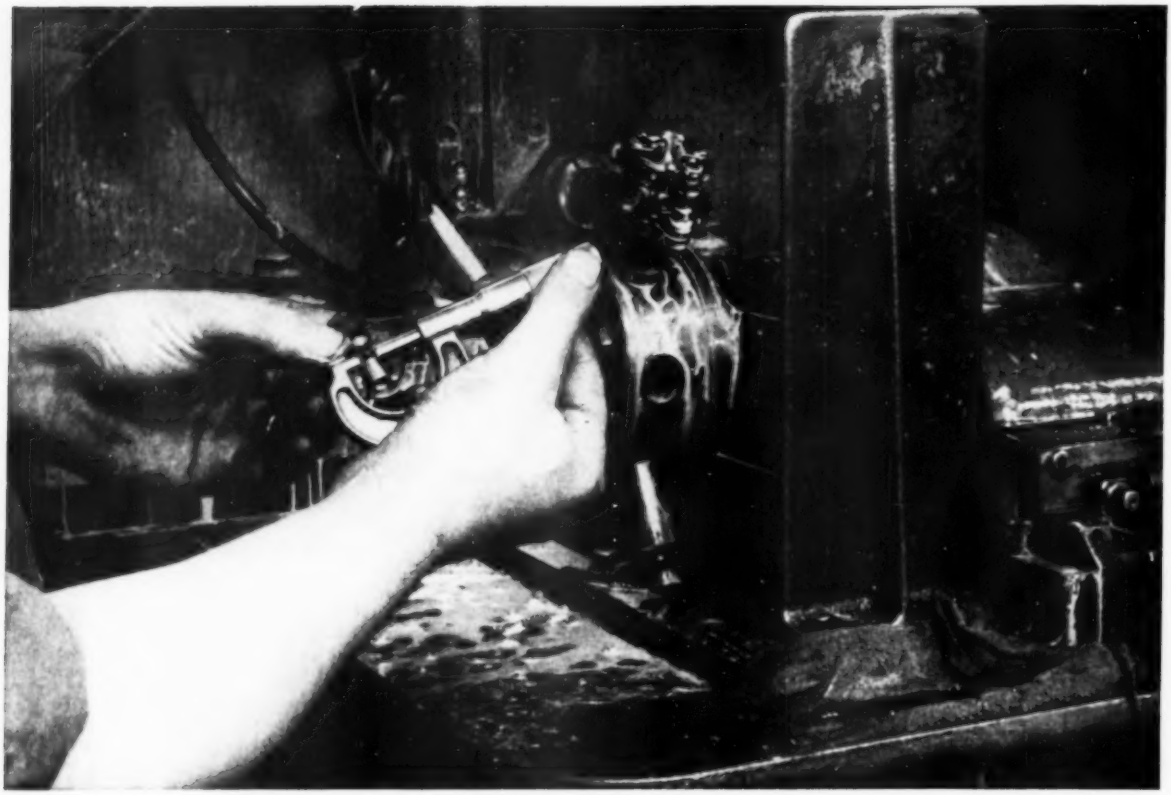
FOR THAT EXTRA EDGE IN PRODUCTION

Brown & Sharpe

CUTTING TOOL DIVISION

HIGH SPEED STEEL CUTTERS
NELCO CARBIDE TOOLS
END MILLS

PROGRESS IN PRECISION FOR OVER 125 YEARS



Machinecraft gets .0005" tolerances with Cities Service Chillo Cutting oils!

Machinecraft, Inc., of Whitman, Massachusetts, makes a product that is surely the answer to many a textile man's fondest wish.

In place of old-style solid arbor top rolls, which often drip lubricant onto the fabric, Machinecraft has developed "the anti-friction top roll."

Operating on ball bearings, this unique invention requires almost no lubrication, therefore eliminates staining problems. In addition, it permits higher speeds of operation and produces more uniformly woven fabric.

In all of this, extremely intricate machining is required —and Cities Service Chillo Cutting Oil plays a crucial role.

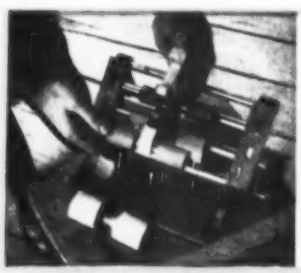
Using Cities Service Chillo "A," Machinecraft is actually achieving tolerances as fine as .0005"! Moreover, Machinecraft reports that Chillo "A" gives "excellent tool life, produces a fine finish, has unusual stability, and offers continuous quality from batch to batch."

"In addition," continues this well known firm, "Cities Service provides us with exceptional technical assistance and good delivery service."

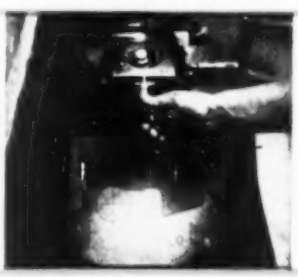
There's little to add to what Machinecraft says except a reminder that *you* can expect similar results with Cities Service, too. Talk with a lubrication engineer from the nearest office. Or write: Cities Service Oil Company, Sixty Wall Tower, New York 5, N. Y.

CITIES SERVICE

QUALITY PETROLEUM PRODUCTS

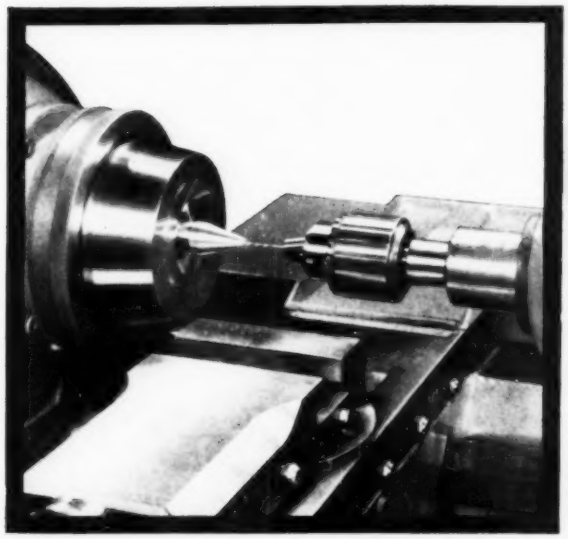


Machinecraft's Anti-Friction Top Roll is rapidly replacing old-style solid arbor type top rolls in textile mills. It prevents staining, permits greater operating speeds.



Shadowgraph is method of checking accuracy of precision machined parts for anti-friction top roll. Machine magnifies and projects the part's shadow outline. Tolerances are as fine as .0005".

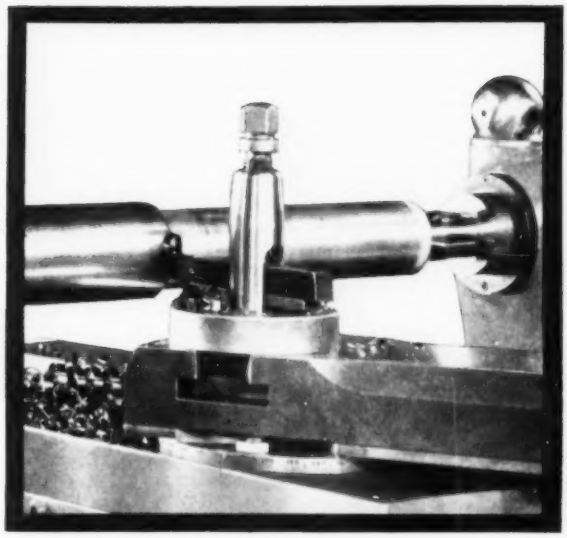
Rivett's 2 for 1 Lathe!



Sensitive...

As An Instrument Lathe

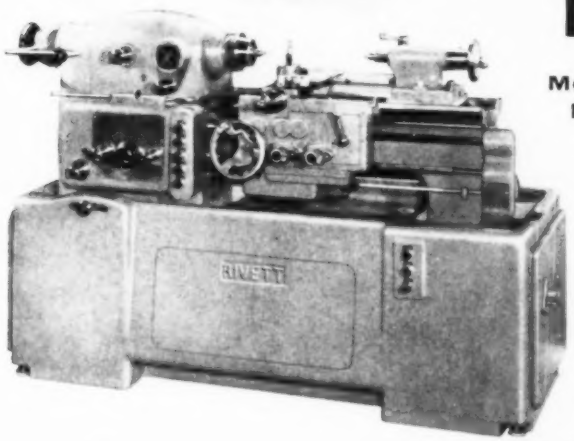
Responds to the lightest touch of the operator. Turns within .0004" in 12" length!



POWERFUL...

As An Engine Lathe

Full horsepower transmitted to spindle. Takes ¼" chip with .020" feed on cold rolled steel.



Model 1020S "Steelway"
PRECISION TOOLROOM LATHE

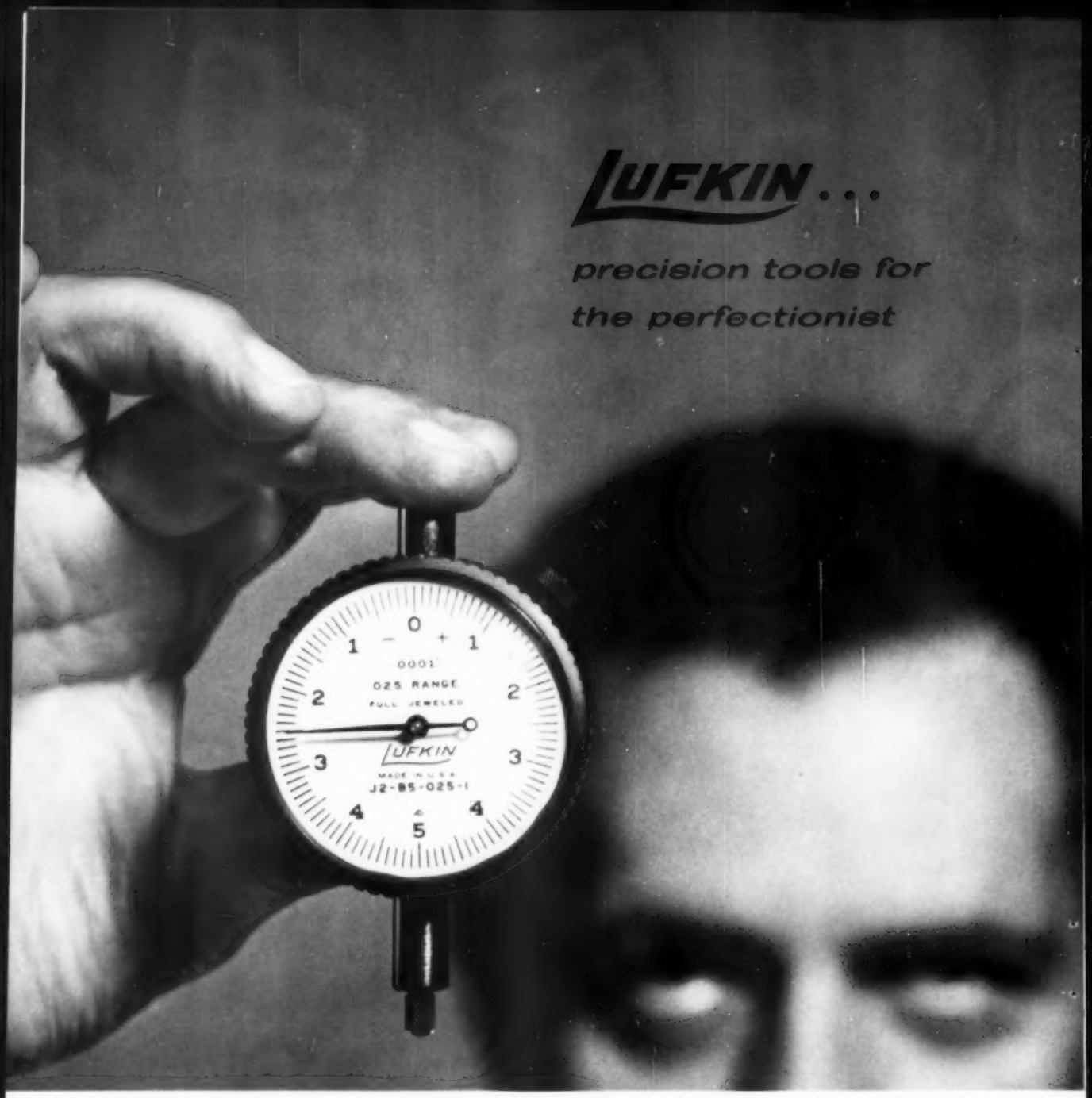
This lathe has the industry talking! Because of extreme precision, it has long been recognized as the top tool by master mechanics. Now, its adaptability and broad usefulness have highlighted its productivity. As one satisfied user states, "Our toolmakers go to a Rivett first in preference to our other lathes!"

RIVETT LATHE & GRINDER, INC.
Dept. A M - 3, Brighton 35, Boston, Mass.

Go to Rivett now for information about this big, beautiful machine.
Send for bulletin 1020B.

RIVETT
"Steelway" Lathes

CIRCLE 249 READER SERVICE CARD



ALL NEW...a complete indicator line

Simplified Advance Design. Precision built for longer life. Full jewelled or plain bearings. Shock-cushion models available. No die castings for any moving parts.

Four Series. A.G.D. Groups 1, 2, 3, 4.

Solid Brass Case. Metal dials have dull-white nonglare background with fine graduations that are easy to read. Both balanced or continuous dials.

Easy Maintenance. Movement is inserted from top. Pivots, gears, rack and pinion are stainless steel for rust and wear resistance.

Always buy from your Lufkin distributor. For complete information on Indicators, write for Catalog No. 51. Lufkin Rule Company, Saginaw, Michigan.

LUFKIN DIAL INDICATORS
TAPES RULES PRECISION TOOLS

SPOT NEWS...

- **Steel that is five times harder yet five times easier to machine** is being investigated by Ford Motor Co and Bethlehem Steel. Japanese process, now being licensed out, has come up with two types: (1) a steel purified by adding a special calcium alloy, and (2) "nodular graphite steel," made by adding calcium alloy to steel containing more than 0.85% carbon. West Germany's Thyssen Steel Works is the first licensee.

- **British metalworking unions' bid for a 40-hour workweek** has been turned down again by employers (current standard is 44 hours) on grounds that "the time is now inappropriate." Now the unions will focus their demands on higher wages.

- **Major breakthrough in the working of tungsten**—deep drawing, extruding and spinning of hot-worked (roller or wrought) pure tungsten plate or sheet has just been accomplished by Fansteel Metallurgical Corp, which at press time would only reveal that powder metallurgy procedures are not involved.

- **Willys Motors' Brazilian plant for production of the Renault Dauphine** will have an initial outlay of $11 million for purchase of machine tools and equipment from eight nations— U S, Great Britain, Italy, Holland, France, Belgium, Germany and Switzerland. By mid-1960 95% of the car will be produced in Brazil at a rate of 50,000 units a year.

- **The old "car that can be sold for less than $1000" dream is back again.** This time it's Montgomery Ward (remember Sears Roebuck's "Allstate" that never got off the ground?) which figures such a "minimum" car would sell 50,000 units a year if marketed through Ward outlets. Germany's Heinkel was to build it, but at last report negotiations had fallen through.

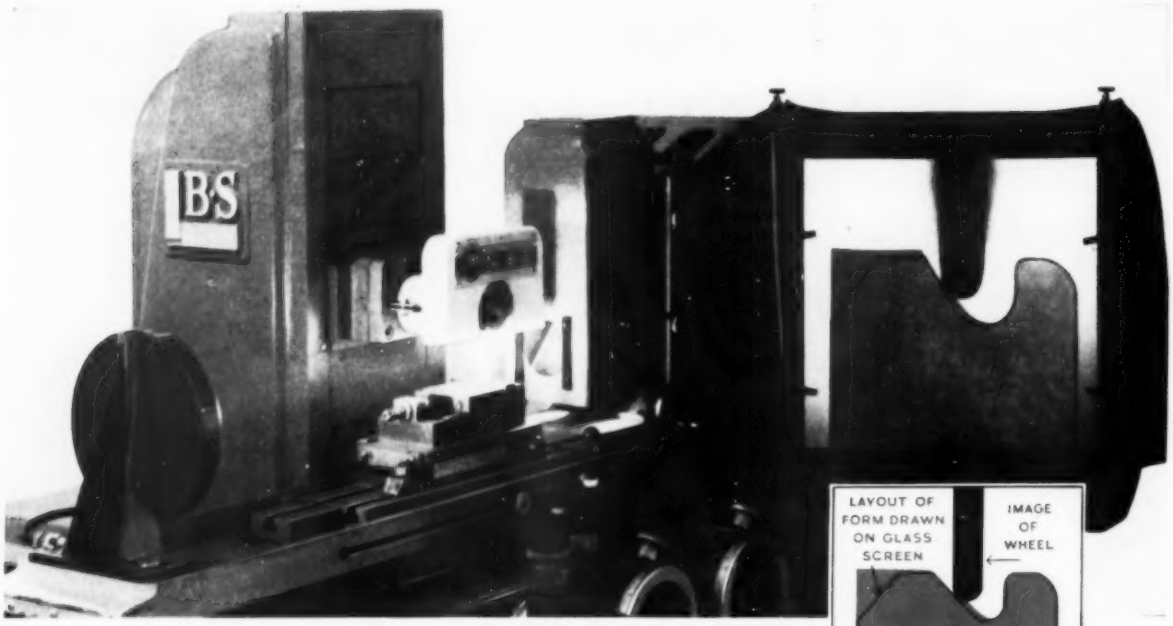
- **Lockheed has developed a new chipless machining process** using a roll extrusion machine now being built by Hufford Corp. The technique involves compressive deformation of the metal with no shearing action so that the material can be reduced accurately to foil thicknesses. Crystal structure of such materials as stainless steel, aluminum, copper, which are worked cold, thus is improved. The same equipment will work with heat 4340 and other high-alloy steels. Big thin-wall sections such as 10-ft-diameter by 24-ft-long missile shells can be produced with integrally formed internal stiffeners or nine radial ribs. The technique also can be applied to manufacture of flat panels with internal stiffeners.

- **Two more electron beam welders are hitting the market**—Air Reduction Sales Co and NRC Equipment Corp machines employing this new heat source. Like the Zeiss and Stauffer-Temescal equipment reported earlier (*AM*—Feb 23 '59, p94), the new machines do contamination-free welding of highly reactive Space Age metals. Still another firm is engaged in developmental work but isn't ready to make an announcement yet.

- **Merger talks are in progress** between Studebaker-Packard and Detroit's Divco-Wayne Corp. Divco, which has annual sales in excess of $24 million, makes delivery vehicles and other automotive specialty units.

- **Shortcut to an atom-powered merchant fleet** has been proposed by Ford Instrument Co, which is awaiting government approval to build a steam-generating nuclear power plant for installation in an Isbrandtsen ship. Plant will be built on land, inside a special hull section that will replace a fuel-storage section in the merchant ship hull. Projects usually require two units: one for development and test, another for installation.

- **Growing imports are causing alarm among steel producers and warehousers.** Wire is being imported at $25 a ton less than U S mill prices, angles at $17 less, and wide-flange beams at $4 less, and it's estimated that about 20% of all reinforcing bars now being used in the U S are imported—at $16 a ton less than mill prices here. Exports normally are about four times imports, now are only about twice the import figure.



Saves 50% or more in contour grinding costs

. . . the Brown & Sharpe MICROMASTER Visual Grind

NO TIME OUT to remove work for frequent inspection with separate equipment. Clear, magnified *true* image of work and wheel constantly in view.

UP TO 75% FASTER set-up and grinding by skilled operators. Semi-skilled workers, also, can readily grind accurate contour to match form layout drawn on screen of built-in comparator, which moves with work.

10:1 TO 100:1 MAGNIFICATION — your choice of six different lens systems as required. Magnification changeover takes less than 2 minutes.

HANDLES UNLIMITED VARIETY of through, blind, template, or circular form grinding with standard equipment or simple attachments . . . in steel, carbide, or ceramics.

BIG SAVINGS IN WHEEL COSTS especially when grinding carbide or ceramics. Intricate forms can be followed with a few simple wheels.

With Visual Grind, the built-in optical comparator system, hundreds of tool and die shops are form grinding twice as fast — often save up to 75% of time previously required.

Now, the MICROMASTER Visual Grind brings you these proved advantages *plus* the profit-saving performance of the new Brown & Sharpe 618 Surface Grinding Machine.

For complete information, call or write any Brown & Sharpe machine tool dealer, district office, or: Brown & Sharpe Mfg. Co., Providence 1, Rhode Island.

Hydraulic table speeds of the NEW Brown & Sharpe 618 MICROMASTER Surface Grinder provide the smooth longitudinal power stroke essential to Visual Grind efficiency. The operator easily follows form with the transverse and vertical handwheels, using .0001 feeds when required.

MICROMASTER Visual Grind is one of over 100 modifications of the new B&S 618 available to meet your specific grinding needs.

Brown & Sharpe

MACHINE TOOL DIVISION

MILLING • GRINDING • SCREW MACHINES

MACHINE TOOL ACCESSORIES

PROGRESS IN PRECISION FOR OVER 125 YEARS

WASHINGTON...

Unionize white collar workers?

AFL-CIO officials are putting new money and manpower into organizing drives. The broad target—14-million white collar workers, six-million industrial workers in the South. The drive will hit across-the-board in industry, with key goals the office and technical employes in metalworking, autos and steel. The send-off is being financed by a chunk of a new $750,000 fund being raised by AFL-CIO through a new 1¢-a-month tax on its 13.5-million members. Says AFL-CIO Organizing Director Jack Livingston: "We want as much of this fund as we can get. We're getting down to business."

The organizing step-up came after Livingston laid out the Federation's membership figures at the recent San Juan, Puerto Rico, conferences of the AFL-CIO Executive Council. He advised union presidents that the "climate is good" for such a membership campaign; that the hurt from the McClellan Committee corruption revelations is about over. Even in the three years since the AFL-CIO merger, he estimates, the Federation has added more than 1 million to union ranks by organizing.

Net AFL-CIO total members (even with 1 million added) is down from 1956. Reason: unemployment in big industrial unions—Steelworkers, Auto Workers, Machinists. Auto and steel memberships are down by 250,000 each: Machinists much less but still hurting.

UAW's Walter Reuther led a campaign at San Juan to stir up the unemployment issue by public demonstrations, legislation drives, collective bargaining demands. The labor leaders came up with plans for all three. Here's where they'll hit:

- Labor bargaining will center on a shorter work week to spread out jobs. Leader here will be United Steel Workers, who are opening negotiations with basic steel in six weeks. Rubber Workers will come in soon after. Machinists, already on a 35-hour week in many plants, will try to extend this. No great success is predicted, however—Reuther failed last year on his 32-hour week demand. Steel might open the door by asking longer week-ends as starter.
- Legislative goal of AFL-CIO is now for a 35-hour week, seven-hour day. This drive, to cut the Fair Labor Standards Act's 40-hour week, is a favorite of Reuther and other union presidents, who have missed on the workweek cut in negotiations.

Here, too, however, predictions are not for quick success. Labor officials anticipate a long campaign before this can score with Congress.

- **Union demonstrations of unemployment** will begin in a few weeks. The plan is to stir up Congress with labor rallies, and to bring thousands of unemployed to the nation's capital. A final plan for AFL-CIO's jobless attitude was worked out in a compromise between Reuther and AFL-CIO President George Meany.

Reuther told fellow labor leaders in San Juan that they should stage a "march on Washington" of 25-40,000 unemployed.

Meany fought back, argued this would backfire, instead proposed an unemployment conference of union officials.

Final decision: A mass rally of several thousand, including groups of jobless from Detroit, Pittsburgh and other key cities.

That old bugaboo: automation...

Automation is a scare-word to the unions. It's full impact has just been felt, since the 1958 recession recovery. Labor economists figure production at about back to normal, but re-hiring is off as much as 20%.

The big fear is that these jobs won't return. They're lost to the machine. That's why the concentration on spreading the available work.

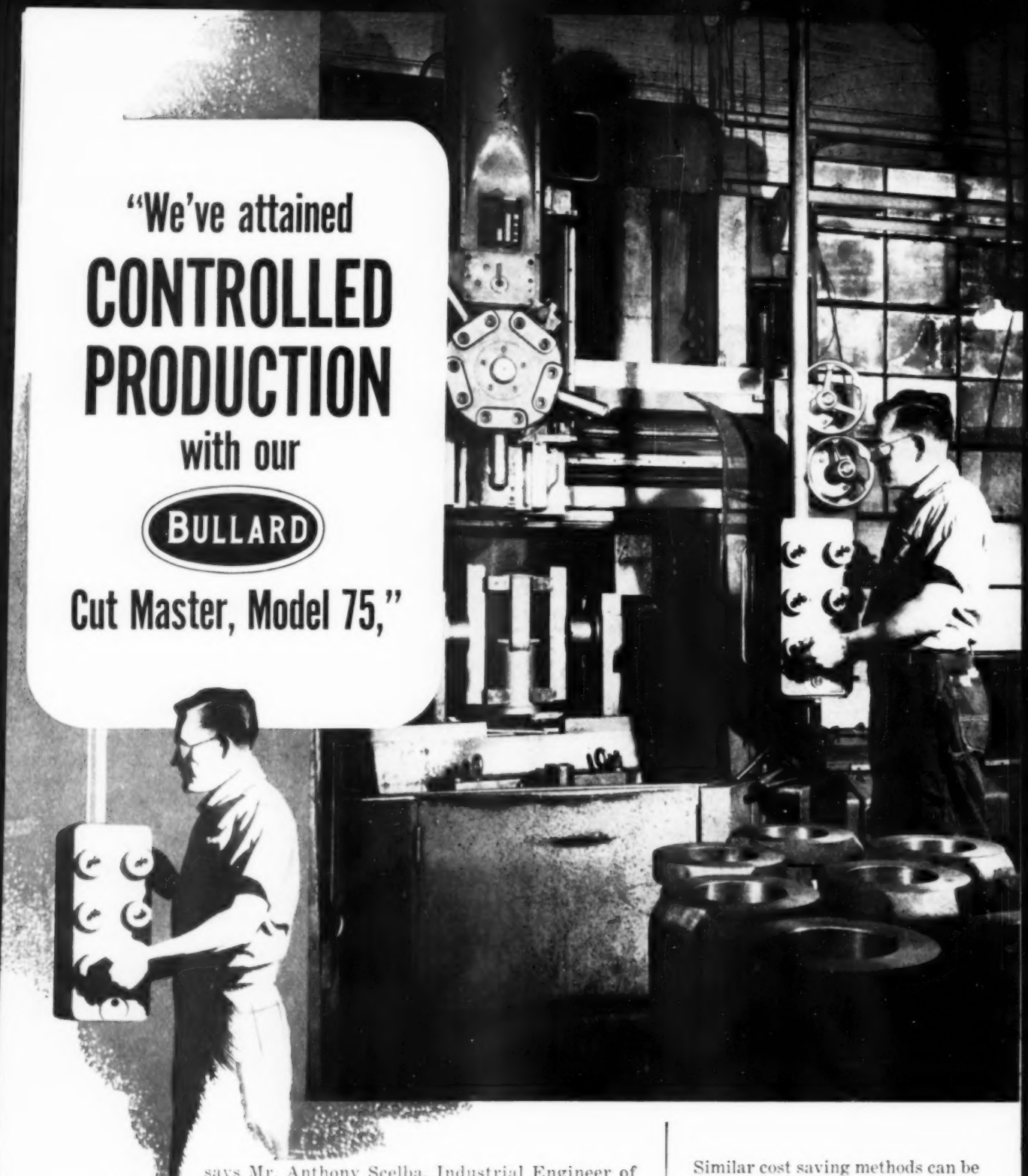
Besides in overall bargaining and legislative goals, automation will show up in other forms. **Unemployed Auto Workers,** for instance, are demanding that Reuther negotiate-out overtime work. They don't want working members to work extra hours while others are out of jobs. Reuther reported this at the Puerto Rico meetings, stirred up interest in the subject. This may well be showing up in local negotiations in areas particularly hurt by unemployment.

But, labor won't fight automation, won't block the plant gate when the new machines roll up. What labor is demanding is the fruits—higher pay from higher productivity. And while labor is worried about the jobless, it isn't about to tone down its wage demands in upcoming bargaining. The shorter work week demand will be for the same take-home pay at least. No cut in wages (no matter how many hours are cut) is foreseen.

Shorter workweek already?

The Federation's shorter work week strategy huddles produced some surprising details. Many labor leaders reported they've long since had shorter hours—in some contracts with the rubber, machine tool, building trades, printing, garment, and brewery industries. The surprise lay in the extent of the contracts—the breakthrough has been fairly heavy. The aforementioned unions will be the leaders in the new campaign—once the mark is made it's easier to extend it.

"We've attained CONTROLLED PRODUCTION with our BULLARD Cut Master, Model 75,"



says Mr. Anthony Scelba, Industrial Engineer of Leslie Co., Lyndhurst, New Jersey, manufacturers of regulators and controllers for industrial and marine steam systems.

Combining a specially designed indexing fixture, which permits indexing the piece in increments of 45° and with the automatic features of Cut Master, every piece leaving the machine is completely finished on all surfaces. This reduces the number of set-ups, for instance, on a four way valve from four set-ups to one. In this manner, production is controlled and a minimum inventory required.

Similar cost saving methods can be applied to your machining problems just call your nearest Bullard Sales Office or Distributor.

THE BULLARD COMPANY

BRIDGEPORT 9, CONNECTICUT

DETROIT...

Chrysler's back...

Sparked by Plymouth, which plans to build 60,000 cars in March, all Chrysler plants have resumed normal operations following settlement of the glass strike. The company as a whole is about 30,000 units behind the pace of the last calendar year—with nearly all of the drop reflected in loss of Plymouth output.

Rumors that Edsel was on the skids were scotched by a letter from Henry Ford II to M-E-L dealers. He flatly stated that the 1960 model will bow approximately October 15 and said that plans were firm for a 1961 model. He did not, however, discuss the size of these cars.

One reason: If Edsel persists in skidding, its moniker could be tacked onto a small car, possibly a slightly enlarged version of Ford's.

Speaking of compact cars in general, AMC's perpetually bullish President George Romney, who is now being unwillingly touted as Republican candidate for Governor of Michigan, says that by 1963 compact car sales will reach 3-million units annually.

He pointedly noted that AMC's "concentrated merchandising effort sells one product philosophy, instead of trying to reconcile the difference between two philosophies."

In other words, he does not expect the advent of Big Three small cars to hurt Rambler sales. Meanwhile, his company is scheduling 100,000 units for the first quarter of 1959—up 16,000 from the record-breaking previous period.

Flexible transmissions...

Contributing to renewed tooling activity are two large transmission programs previously reported. Chrysler is revamping its Powerflite and Torqueflite units, with the idea of simplifying the former to the point where it could conceivably be offered as standard equipment. Those who want more speeds and smoothness can then specify an optional added unit, much the same way as overdrive is tacked onto a manual transmission today.

GM's Detroit Transmission Division, in turn, is tooling a new series of Hydra-Matics. Aside from mechanical changes, interest lies in devising case designs that will permit the car division customer to later move to a trans-axle without further significant transmission tooling. As used in the orthodox position, the box is shaped so that its bulk spreads sideways, thus nearly eliminating the objectionable hump in the front compartment.

Despite rumors, Cadillac will not be offering the alternate, rear position for 1960 models.

But from another point of view, Hydra-Matic's multi-purpose case will solve a major trans-axle drawback. Space must be found for the transmission, even when mounted in the rear adjacent to the axle.

This is fine in sedans, where the room can be absorbed in the trunk. But on station wagons, it could preclude a third seat or at least cut seriously into cargo space. The optional front mounting is the solution to this growing specialty market.

Tractor growth...

Massey-Ferguson, Canadian-based farm equipment manufacturer, is the largest in its industry—but this size stems from overseas activity. Last year, this column reported a concentrated effort to penetrate the North American market.

Results are now in. The company reports a whopping but still projected first quarter increase of 75%. The company now stands about fifth in U S wheeled tractor sales. These figures lend encouragement to expansion plans.

Only recently, M-F opened a Detroit plant for manufacture of gears and axles. Enlargement of Wichita facilities is in the wind. M-F has acquired F Perkins Ltd, English manufacturer of diesel engines, and is nearing agreement with Britain's Standard Motors to trade its 25% stock ownership for Standard's tractor-producing facilities.

M-F's current annual volume is about 34,000 units in the U S. Of this, about 10% represents industrial tractors. Sales Manager Ward W Dworshak predicts that in five years production will climb to between 50-60,000 tractors.

Chrysler goes amphibious...

On April 1, Army officials at Fort Bragg, NC, will see demonstrated a new series of amphibious vehicles that are light enough to be parachuted to the scene of combat. Eight independently sprung wheels give better traction and flotation on land than most track-laying vehicles in current military use have.

It will be offered in 4-, 6-, and 8-wheel drive versions. Standard commercial Chrysler engines, transmissions, drive lines and axles will be used—an adaptation that will greatly reduce tooling costs. The all-aluminum hull surrounds all moving parts (including brake drums), to give protection while the vehicle is in amphibious use. It will carry two-thirds of its own weight in payload under combat conditions.

MULTIPLE FEED-OUTS...

A Natural

on Greenlee Air-Feed Automatics

Feed Out Stock to 16½"
Eliminate Pushers and Feed-Out Cams

Removable fittings attach air lines to the stock reel tubes. A vacuum pump withdraws the piston when restocking. Push-button control panel is provided for starting and stopping.

Greenlee Air-Feed Automatics offer you a 3-way profit advantage:

1. Maintenance and change-over time is reduced by eliminating stock pushers, feed tubes and feed-out cams.
2. Stock can be automatically air-fed to position in one or more machining stations permitting two or more pieces per cycle.
3. Multiple feed-out flexibility enables you to finish machine a variety of pieces that ordinarily demand costly second operation setups.

If you are running into production headaches on a specific job, Greenlee may be able to adapt an "Air-Feed" to solve your problem. See your Greenlee Distributor.

Write for your copy of Catalog A-405 — first step on the way to more profitable production with Greenlee Automatic Bar Machines.

• • •

Greenlee Standard and Special Machine Tools

Multiple-Spindle Drilling and Tapping Machines

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Six and Four-Spindle Automatic Bar Machines

Hydro-Borer Precision Boring Machines

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ROCKFORD, ILL.

AIRCRAFT and MISSILES...

TRENDS

APT and metalworking...

News of a language that tells machine tools what to do made headlines a couple of weeks back. Called APT (for Automatic Programmed Tooling), the 107-word vocabulary is a tool for the part programmer, who up until now has had to make a laborious interpretation of a drawing so that it can be transcribed on to a tape that directs numerically controlled machine tools. (Details on p106.)

APT, developed by the Air Force, Air Materiel Command and MIT, is not a more advanced system of numerical control. Rather, it is a tool that allows a tool engineer, design engineer, master mechanic, or even a skilled machinist, to program a workpiece for tape preparation.

Thus, in effect, APT takes programming out of the realm of highly skilled specialty work and puts it into the shop man's hands. APT can be applied to any general-purpose computer—will prepare data acceptable to most machine tool director systems now in existence.

A fairly simple part requires something like 200 man hours to program with conventional desk calculators. With APT, the same part can be programmed in four hours. (But in all fairness it must be mentioned that some other computers can program such a part in 3 to 10 hours.)

APT's distinct advantage over other systems is that it eliminates the need for computer specialists. Too, it can prepare programs for any machine tool director system. And its future possibilities for a wide variety of metalworking applications are almost unlimited.

At present, APT can produce 3-D machining curves by using straight lines and circles. Work is now going on at MIT to develop an APT system that will program entire surfaces by using a combination of circles and spheres.

In other words, using APT a cutter will one day be able to start (theoretically) at a point in space, sculpture any desired shape, skip to any other point and generate another surface—and that's automatic machining in anybody's book.

In fact, APT may one day so revolutionize automatic machining that its end product may be parts resembling human bones—nature's ultimate in structural design.

New curbs on system contracts...

Unprecedented restrictions on contractors are included in a new Air Force prime development contract award to ITT and RCA, providing a tip-off on future curbs for system contracting.

The new project, the 480L Communications Support System, is aimed to expand and modernize the Air Force's present world-wide communications network, which Pentagon strategists consider inadequate for future requirements. The project is starting out at a modest $3-million level to cover preliminary study and design work, is expected to eventually burgeon out into orders for considerable electronic hardware production.

The new restrictions have been clamped on ITT and RCA to prevent the firms from cornering future business evolving from the project.

The contractors are prevented from designing or engineering the new communications system so as to "accrue an advantage in subsequent procurement" over other electronic companies. They are directed to compete "where feasible" with other producers for fabrication of components. And most significantly, they are limited to a level of new orders from the project "reasonably related" to the volume of Air Force business the firms have had in "prior years."

Next: Mars, Venus, the Moon?

Space Administrator T Keith Glennan told Congress recently his budget soon would top $1 billion a year. The money will go for such things as communication satellites, space stations, manned space flight, etc.

Among the new space vehicles NASA is developing are these: By mid-1960 tests will start on a new "work horse" vehicle—dubbed the "Scout." Entirely solid-fueled, its cost will be around $450,000—about one-fifth of present vehicle costs. It will be used extensively for weather and communication satellites, and the like.

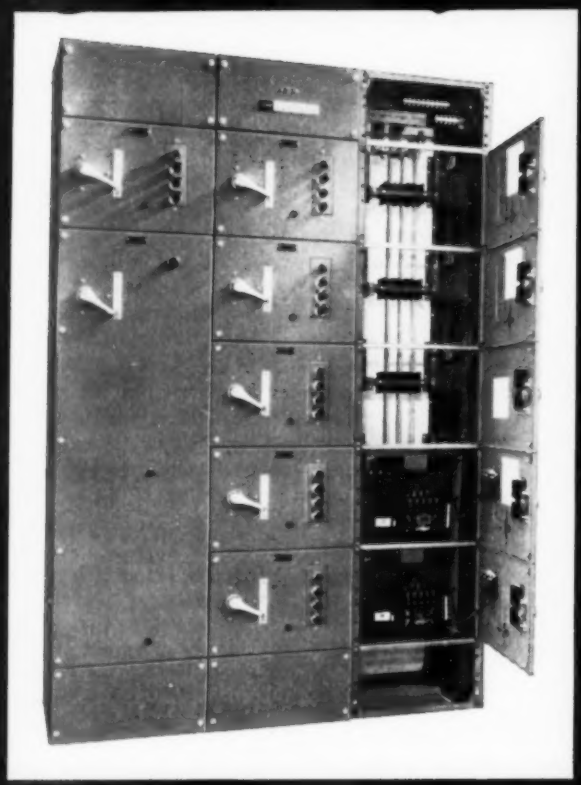
Within the next couple of years, NASA will have two other space vehicles: "Vega" and "Centaur." Both are three-stage rockets that will be capable of putting 1000-lb payloads on Mars, and 6000-lb satellites in orbit around Earth.

Within the next four to five years there will be still another generation of rockets. One will be a five-stage rocket that can send 20,000 lbs to the moon. The other will be a 6-million-lb-thrust, five-stage rocket that can carry 2000 lb to the moon and back; carry 7500 lb to Mars, with a 750-lb return load.

NASA hopes to have a nuclear powered rocket developed by then, too. If so, it will be used as an upper stage rocket that can carry 55,000-lb to Mars, with a 25,000-lb return load.

In Control Centers...

Federal Pacific gives what you're looking for



RELIABILITY

BOLTED CONSTRUCTION—11-gauge formed channels bolted together for maximum structure rigidity.

POSITIVE PLUG-IN CONTACTS—special beryllium copper alloy stabs provide high-pressure, low-resistance unit-connections to silver-plated bus.

TESTED TO WITHSTAND 25,000 AMP RMS SHORT CIRCUIT STRESSES.

FLEXIBILITY

PREPUNCHED STRUCTURES—for unmatched job flexibility...individual units or complete sections can be added, removed or interchanged to meet varying job requirements—present and future.

COMPACT DESIGN—up to 20 units can be mounted in a single vertical section.

EASY WIRING—oversize wiring spaces simplify initial installation and facilitate change of units.

SAFETY

UP-FRONT UNIT RELEASE—completely disengages unit from energized bus... can be locked in open position to prevent accidental contact.

FULLY ENCLOSED UNITS—steel barriers isolate each unit from adjacent parts.

DOORS MOUNT ON STRUCTURE—prevent accidental contact with energized bus when starter unit is removed.

Nothing has been left to chance in the design of this control center. Structure, starters, and protective devices have all been carefully engineered, manufactured and coordinated by Federal Pacific to assure the highest standard of operating efficiency and dependability—as well as to provide unified responsibility for performance. For complete details write for Bulletin 2-2000A, Federal Pacific Electric Company, General Offices: Dept. 305, Newark 1, New Jersey.

FPE

FEDERAL PACIFIC ELECTRIC COMPANY

The Best in Electrical Distribution and Control Equipment

MACHINE TOOLS...

Clearing to sell Harrison lathes...

Clearing Machine Corp, division of U S Industries Inc, has acquired sales rights in this country and Mexico to the complete line of geared-head, gap and copying lathes, in sizes 11 in. to 16 in., built by T S Harrison & Sons Ltd, Heckmondwike, Yorkshire, England. The Harrison line will complement the Axelson lathe line which begins with 16-in. machines and goes to larger sizes.

Final net cost to U S users, delivered to users' plants, will be about one-third less than prices of comparable-size American lathes.

Initial shipment of 50 Harrison lathes is expected to arrive in this country during March. The Harrison line will be built to U S standards, will carry a Clearing guarantee and will be sold through Clearing distributors.

Clearing hopes to extend the sales agreement with Harrison to include Hawaii, Puerto Rico and the Philippines. U S Industries Inc, has subsidiary companies operating in each of these countries. In Mexico, Clearing will work with the International Division of U S Industries in selling Harrison lathes.

Revolution in machining...

A revolution in machining and design is going on in the automobile industry, H Glenn Bixby, president of Ex-Cell-O Corp, said recently in a talk to members of the Cutting Tool Manufacturers' Association.

Forgings continue to be replaced by stampings and the multiplicity of machining operations will be reduced by the trend toward aluminum engines, he said. Cutting tools will have a life span of three to four times longer. New types of machine tools requiring more precision and higher speeds and feeds for aluminum will be introduced. Over-all there should be no reduction in total demand for machine tools, according to Mr Bixby. The machine giving highest output at lowest cost will be in greatest demand.

Mr Bixby advocated that the United States discard its protectionist trade policy and work toward elimination or reduction of tariffs and other trade barriers. He said that "as we reduce our barriers to imports, we must see that foreign nations reciprocate" because foreign trade is a two-way street.

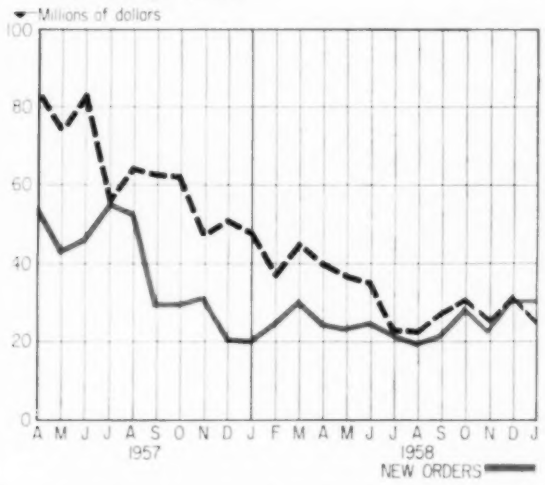
American business should keep in mind these facts, Mr Bixby asserted: 1) the European market is growing, 2) Europe "will hurl increased competition within our own borders," 3) European competition will be much livelier in other world markets, 4) American investment in Europe will have to be accelerated to cope with competitive forces.

Though "we have always insisted that our foreign subsidiaries were complete entities," he said, "our recently acquired operation in West Germany is barred from filling iron curtain orders. It can neither buy nor sell with the Reds, while its competitors in that country are permitted to do so."

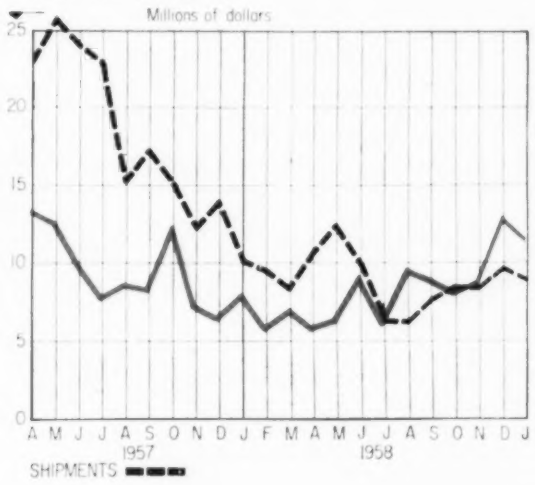
It is a mere question of time, Mr Bixby prophesied, until the Soviet countries will be exporting more elaborate machine tools. Machine tools produced in Communist countries are being priced in Europe at 25% of similar U S types.

BF

Metal-cutting machines



Metal-forming machines



What's New

IN STEEL FROM STOCK

New developments will help give you Increased Value in Buying Metals from Ryerson during 1959. Below are just some of the new additions to Ryerson's comprehensive stocks and services.

NEW FASTER MACHINING TUBING... Ledloy® 170—fastest machining steel tubing ever produced, average speed of 170 s.f.m. And only Ryerson has it for shipment from stock. Users report increases of 25% in productivity... longer tool life...improved finish. Sizes available to date from 1" to 2½" O.D. with maximum ⅜" wall thickness.

NOW EVEN FASTER MACHINING LEDLOY BARS... new Ledloy 375 bars boost machinability to record averages of 375 s.f.m. Large stocks of this new steel supplement Ryerson stocks of regular Ledloy 300 free-machining steels to give you widest selection. Available from Ryerson stocks in rounds from ¼" to 1", hexes from ¼" to ⅝".

TWO NEW PLANTS IN TEXAS... the former plants of Vinson Steel and Aluminum Co. in Dallas and Houston are now a part of the Ryerson organization. These plants, already well stocked and equipped, are now backed up by the unequaled facilities of the 18 other Ryerson plants across the nation. This means Texas metal users can now draw on stocks of more than 12,000 kinds, shapes and sizes of steel and aluminum. Also available, full line of industrial plastics and metalworking machinery.

NEW ALUMINUM STOCKS... are being added in Ryerson plants at Cleveland, Philadelphia and Los Angeles. Aluminum stocks at other Ryerson plants have also been greatly expanded.

NEW STOCKS OF T-1 ALLOY PLATES... in two types: to 321 minimum BNH and to firebox quality specs. "321" gives maximum resistance to impact and abrasion. Five sizes available from 3/16" through ⅝". "Firebox" is for applications requiring high strength and toughness...meets ASME code case 1204-3 for pressure vessels. Available in nine sizes from ¼" through 2". Both types offer good weldability.

STAINLESS EXTRUDED ANGLES... now available from Ryerson. They offer better surface and resultant lower polishing costs...cross-section tolerances less than half those of rolled angles for better forming into rings...no increase in price over rolled angles.

INCREASED VALUE IN STAINLESS FROM RYERSON... even though your application may not demand it in every case, you get the ultimate in specification controls when you order stainless from Ryerson—an important increased value without increased cost. Examples: in addition to chemistry specs for Types 304 and 316, you get the added value of controlled mechanical properties and Brinell hardness—and corrosion resistance assured by actual test.

STAINLESS HEADS—NATION'S LARGEST STOCK BY FAR... Ryerson stocks now include every requirement for ASME flanged and dished heads in Types 304, 304L, 316 and 316L in a wide range of gauges and sizes.

RYERSON STEEL®

Member of the Steel Family

NATION'S MOST COMPLETE SERVICE ON STEEL... ALUMINUM... PLASTICS... METALWORKING MACHINERY

SERVICE CENTERS IN PRINCIPAL CITIES COAST TO COAST

MATERIALS... TRENDS

Proposed projects...

Manufacturing Methods Division of the Air Materiel Command, USAF, investigates about 156 projects each year in an effort to improve the producibility of military aircraft.

Out of these studies have come many of the most advanced techniques in modern metalworking and a number of valuable materials. Some of the proposed projects thought worthy of further consideration offer valuable insight.

Further study of tungsten castings and other refractory metals as to producibility, formability, and fabricability, is urged. Tungsten has mechanical and physical properties which demand its serious consideration as a highly important material for use in new and future high performance aircraft and missiles, which are extremely sensitive to high operating temperatures. It has the highest melting point and thermal characteristics of any available refractory metal. Tungsten castings may overcome some of the problems. There is an immediate need for strength data and design criteria.

A similar study is proposed for tantalum, which is very ductile at low temperatures. Indications are that tantalum could fill a gap between 1200 and 1700 F. Projects are under way in studying the use of columbium and molybdenum castings. Another approved project concerns an improved method for induction melting of titanium and other rare reactive metals in cold crucibles. New materials to be developed and evaluated will include beryllium, zirconium, hafnium, vanadium, chromium, uranium, columbium, molybdenum, and tantalum.

Long lead time of conventional extrusion billet production is expensive and the in-process operations of melting, blooming, rolling, and cutoff are inflexible for short-run operations. A project has been approved which will attempt to develop quicker and more flexible operational processes for the production of high-temperature extrusion billets by powder metallurgy. Extrusions, Inc (Caldwell, N J) has received a AMC contract to develop a device and operational process to extrude parts of steel and titanium by explosive processes. National Northern Corporation (West Hanover, Mass) has a contract to develop explosive forging. Both contracts should be completed by summer.

New urgency to develop extremely-high-temperature structural material for missiles has reawakened interest in graphite as a general purpose material where the highest possible strength at high temperature is the objective. Wide differences are found in the machinability of the material for specific applications. An evaluation of product differences of carbon and/or graphite is recommendd. It should result in comprehensive engineering and physical data to aid in establishing competent machinability.

A new form of reinforced plastic has been developed in the laboratory, in which small and very thin glass flakes are used as a reinforcement—instead of fibers. Sample laminates show flexure modulus/sp gr ratios consistently exceeding three million psi. This is equivalent to common structural materials such as steel, titanium and aluminum and twice the normal modulus for plastic and glass-laminates. A study is proposed to determine manufacturing methods for using this material. In the laboratory development stage are inorganic polymers with high strength/weight ratios and a long-time temperature range over 1000 F.

Steel that floats...

Floating stainless steel has been developed by Crosley Division, AVCO Manufacturing Corporation. Development grows out of Crosley's porous stainless steel made for missiles and aircraft which was found to be buoyant in water.

Quartz...

Simulated crystals of synthetic quartz are being made by a process, hydro-thermal crystallization, in which high temperatures and high pressures are applied to an aqueous solvent. Process dissolves an ordinary hard material so that it can be crystallized on a crystal seed.

New process should make US independent of main source of supply (in Brazil) of the larger natural quartz crystals used in communication equipment. According to R A Landice, Bell Telephone Laboratory, and R A Sullivan, Western Electric Company, synthetic quartz can now be produced in the U S on a large scale. Natural source is apparently depleted.

Wooden bearings...

Longevity of wooden bearings on machines, ship-propeller shafts, and railroad engines, exceeds that of nonferrous metal and cast iron by up to 300 percent according to reported Soviet tests. Birch, alder, linden, and willow are used. Disks are cut from cylindrical rods, bent in a 100-110 C steam bath, and dried to semicircular form. It is important that the cut fibers be vertical to the bearing surface.

BIG, NEW ADDITION

to SIMONDS' COMPLETE LINE of "Red Tang" Files

NEW MULTI-KUT
FLAT

This MULTI-KUT FLAT file is similar in shape to the Regular Flat File. Fast cutting, it leaves a smooth finish and gives good results on any fileable material. Furnished in 8", 10", 12" and 14" lengths.

NEW MULTI-KUT
HALF-ROUND

This MULTI-KUT HALF ROUND combines two exclusive SIMONDS file designs: Multi-Kut on the flat side, Spiral Cut on the radius side, resulting in rapid, smooth finish filing of either flat or concave surfaces or for rounding out holes. Furnished in 8", 10", 12" and 14" lengths.

NEW MULTI-KUT
SQUARE

Cut on all four sides and tapered toward the point, this fast cutting MULTI-KUT SQUARE file is especially useful in slots, keyways, splines, square holes and general surface work. Furnished in 8", 10", 12" and 14" lengths.

The New Simonds'
MULTI-KUT FILES
...with Criss-Cross Design

The Simonds' line of files — files that cut fast and smooth, last longer; files that bring *smiles of satisfaction* are now even more complete with the addition of Simonds' new design Multi-Kut — in three shapes, four lengths.

The new diamond formation chip breaking grooves and varied shapes make the Simonds Multi-Kut an extremely useful all-around file for maximum stock removal, smooth finish and long life on any fileable material.

For Fast Service from Complete Stocks
Call your
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WHAT'S AHEAD... in Metalworking

TRENDS

Metalworking's slow climb continues...

U S metalworking production is continuing its slow, steady climb in virtually all major segments. Lone exception is the automotive industry, which has dropped off in production since December, after a rather spectacular jump in output as the new 1959 models hit the market. But even automotive production is running well above year-ago levels.

Production of major appliances, on the other hand, continues to set new records almost daily. **Basic steel production,** under the artificial stimulus of a prolonged steel strike threat, is going strong. National output is running at about 83% of capacity, and incoming orders continue to outstrip production by a wide margin.

Steel warehousers also report heavy demand, particularly for flat-rolled and plate, even though there are no reports of allocations. Some buyers are asking the warehouses to store steel bought as a hedge against a strike, but warehousers are reportedly refusing to do so.

Demand for steel sheet is very heavy, with orders coming in from Chicago-Milwaukee, Pacific Coast, Atlantic Coast and the Detroit-Cleveland-Buffalo areas, in that order.

Car makers have heavy orders in for sheet, are filling Detroit area warehouses. Flat-rolled products are just about sold out for first half 1959.

Auto parts makers, in fact, have accumulated stocks of steel so large that most of them won't be doing any buying for six to eight weeks if the anticipated steel strike doesn't occur.

Screw machine products manufacturers report that they chalked up the highest dollar order rate in their history in January—a gain of 57% over January 1958 business. This represents the ninth consecutive month that business has improved, and the outlook continues to be excellent, with incoming orders still running ahead of shipments.

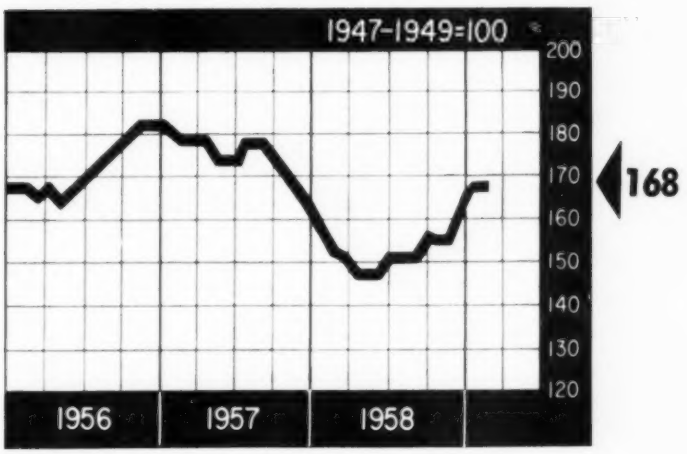
Tool and die industry outlook remains somewhat spotty. Latest industry figures show an overall substantial increase over last year's levels, but reports of individual companies vary widely. **One firm, for instance,** says business is up 50% over 1958 levels, but is dropping off now. Others say, variously, that auto and appliance orders are (1) lagging, or (2) finally picking up.

Plating shops also report that business is spotty. Some have been hard hit by the slowdown in manned aircraft production, others by the increasing tendency of automotive manufacturers to do their own plating work. Plating competition is strong, and profit margins are cut thin.

Manufacturers of railway equipment (mainly track supplies) claim they have doubled their backlogs over the last six months—currently have about a third-of-a-year's business on hand. Still, they say, incoming orders "aren't what they should be."

Makers of roadbuilding machinery, on the other hand say that business is running well ahead of last year and is expected to improve still further with the advent of warm weather.

Drop forging business has reportedly improved considerably in recent weeks but it's admittedly still "nothing to shout about" because year-ago new orders were practically nil. Intense competition and price slashing—hangovers from the recession bottom—are still hurting the drop forging business.



AMERICAN MACHINIST INDEX OF METALWORKING PRODUCTION

BASED ON MANHOURS WORKED IN THE FIVE COMPONENTS

	FEB Estimated	JAN Preliminary	DEC Revised	JAN Year Ago
Total Index	**168**	**167**	**165**	**159**
Machinery	134	132	132	
Electrical Machinery	200	190	192	
Autos	135	141	120	
Other Transportation	330	314	318	
Other Metalworking	144	143	135	

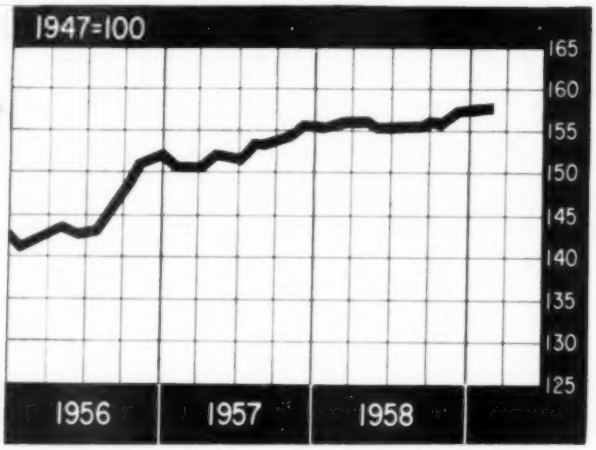
TRENDS

WHAT'S AHEAD... in Business

AMERICAN MACHINIST INDEX OF METALWORKING PRICES

	FEB Estimated	JAN Preliminary	DEC Revised	JAN Year Ago
Total Index	**158.4**	**158.2**	**157.9**	**156.2**
Metalworking Machinery	**182.4**	**182.2**	**183.0**	
Other Machinery exc. Electrical	**169.5**	**168.8**	**166.6**	
Electrical Machinery	**158.8**	**158.6**	**157.2**	
Fabricated Metal Products	**148.6**	**148.4**	**146.8**	

158.4



Industrial output headed for all-time high . . .

Business activity is forging ahead. The January index of industrial production was 143 (1947-1949=100), February will probably hit 145 and output will probably reach the 150 level sometime this spring. This will be an all-time high for production in the U S.

Gross national product (the dollar volume of all goods and services produced in the nation) is continuing to register substantial gains. The current estimate for GNP is $462 billion. It will climb very close to $470 billion in the second quarter.

Something new has come on the scene. What is happening now is that metalworking firms are building up their steel inventories to beat the threat of a strike, also as a hedge against rising steel prices. This recent surge of new orders going to the steel industry suggests that the business curve will follow a slightly different pattern than was expected at the end of last year.

The result of all the current steel buildup will be that industrial production will not rise steadily throughout the year. Actually we can look for a bulge in the second quarter and a possible dip in the third quarter. The third quarter dip will come now whether we have a steel strike or not, because inventories of steel will have been built up to a fairly substantial level by the end of June.

The gross national product may be expected to continue its upward course whether or not there is a steel strike since GNP covers many other areas than the manufacturing and mining fields. Its upward course will be slowed down some in the second half of the year. We can no longer expect it to forge ahead an equal amount in each successive quarter.

For the next six months, two major sectors of the economy will be contributing to the over-all gain in GNP. The most important is the consumer. He will be buying larger quantities of appliances, cars, clothing and food. The government is the other important sector where increased spending on goods and services will contribute to a gain in GNP. The business sector in total will likely show no major changes from the first quarter level.

WEEKLY BUSINESS INDICATORS

	Latest Week	Preceding Week	Year Ago
Business Week Index of Activity (1947-1949=100)*	149.8	148.9	129.5
Steel ingot operation (thousands of tons)	2,481	2,449	1,475
Electric power output (million Kilowatt hours)	13,259	13,156	12,338
Production of automobiles and trucks	155,844	150,019	114,930
Engineering construction awards (Eng. News-Record—millions)	$285.7	$398.3	$304.7

MONTHLY BUSINESS INDICATORS

	Latest Month	Preceding Month	Year Ago
Index of industrial production (1947-1949=100)*	143	142	133
Index of durable manufactures production (1947-1949=100)*	145	144	135
Durable goods manufacturers' sales, millions*	$13,589	$13,295	$13,092
Machinery manufacturers' sales, millions*	$ 3,933	$ 3,951	$ 3,954
Durable goods manufacturers' new orders, millions	$13,542	$13,574	$11,399
Machinery manufacturers' new orders, millions	$ 3,989	$ 4,019	$ 3,422
New Orders for Nonelectrical Machinery (1950=100)*	161	140	125
New Contracts for Industrial Construction (1950=100)*	97	80	99

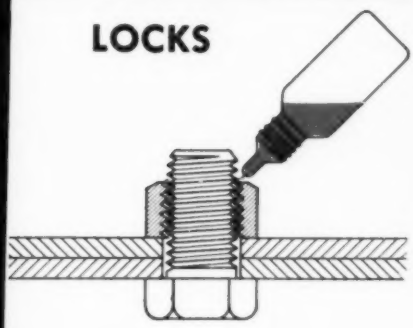
* Seasonally adjusted

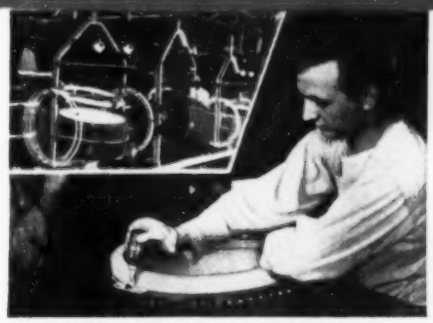
LIQUID LOCK FOR METAL PARTS CUTS COSTS IN PRODUCTION, MAINTENANCE AND SERVICE !

Loctite is a thin liquid that hardens between closely fitting metal parts. It forms a tough heat and oil-resistant bond that secures threaded parts; retains bearings, sleeves; seals pipe and tubing joints. Parts treated with Loctite may be stored for days . . . lock only when assembled.

LOCTITE® provides new methods which simplify assembly

LOCKS





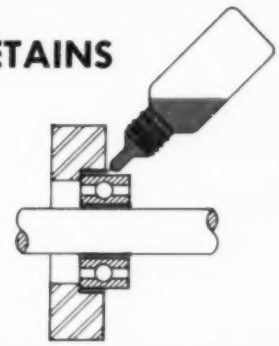
Locking tightened nuts with Loctite on the production line General Electric Filter Flo Washers

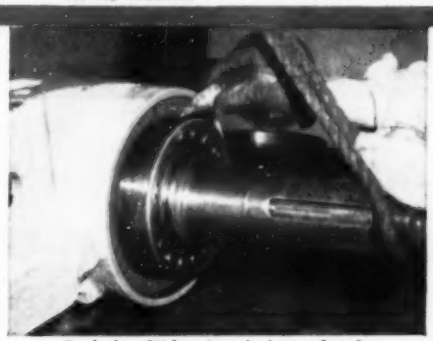
LOCKS NUTS TO BOLTS

Locks and Seals Set Screws, Machine Screws, Studs, Adjustment Screws

- One drop replaces lock nuts, lock washers, lock screws, staking, jam nuts, and interference threads
- Makes any threaded part *self-locking*
- Cuts breakdowns and service calls due to loosening of fasteners
- Highest resistance to shock and vibration
- 4 strengths provide any required locking torque

RETAINS





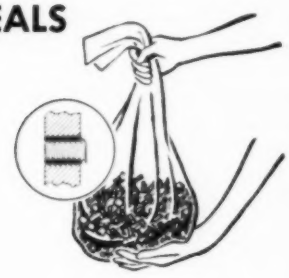
Replacing 9" bearings in jaws of rock crusher, using clearance fit and Loctite. Acme Road Machinery Co., Inc.

HOLDS BEARINGS, OIL SEALS, AND BUSHINGS WITHOUT PRESS FITS

Secures Rotors and Hardened Sleeves to Shafts

- Allows easier tolerances—cuts rejects, rework. Improves alignment.
- Speeds production — parts slip together by hand, lock *after* assembly.
- Eliminates bearing distortion, cracked races, split housings.
- Simplifies field replacement — eliminates reboring, sleeves, shims, weld metal builds.

SEALS



Pipe plugs tumbled with Loctite seal JP-4 fuel at 800 psi in jet fuel control. Hamilton Standard—Div. United Aircraft

SEALS JOINTS AGAINST HIGH PRESSURE FLUIDS

- *Completely* fills joints with tough plastic. No solvents to evaporate, no voids.
- Resists heat, cold, fuels, oil, water, solvents, most chemicals.
- No cleanup problems. Spillage outside joints stays liquid — washes off.
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Now it has been proved . . . grinding wheels containing General Electric man-made diamonds *actually out-perform natural diamonds!*

In actual production, G-E man-made diamonds have maintained sharper cutting edges, have cut more freely. They top natural bort because rigid manufacturing control maintains uniform quality. G-E man-made diamonds are more blocky and rough surfaced . . . provide extra support in the bond. They are also more friable, so that sharp, new cutting edges are constantly presented in the grinding operation.

Wheels made with General Electric man-made diamonds are available *in quantity* now. They'll deliver a production bonus averaging 35%. Be sure *you* cash in on this superior performance by specifying wheels containing G-E man-made diamonds from your regular wheel supplier. *Metallurgical Products Department of General Electric Company, 11149 E. 8 Mile Road, Detroit 32, Michigan.*

METALLURGICAL PRODUCTS DEPARTMENT

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American Machinist
MAGAZINE OF METALWORKING PRODUCTION • ESTABLISHED 1877

To Correct an Unhealthy Situation

All segments of the metalworking industry did a whopping business back in 1955. The automobile industry in particular hit an all-time high.

Then came a year of reckoning for Detroit, in 1956. Car orders and shipments fell off considerably. The next year, 1957, was a repetition of 1956, with car makers crestfallen over their relatively poor showing.

This bad turn . . .

in automotive events strangely did not have the usual overwhelming effect upon the rest of Metalworking. Metalworking production refused to budge from its high perch and, in 1957, climbed even higher to a new peak of $130 billion.

Metalworking's ability to stay up, in spite of a mediocre performance by the automobile industry, was no fluke. For Metalworking, like industry in general, was in the midst of a capital goods boom. We began to hear a slogan "as capital goods go, so goes the national economy."

This slogan fitted the situation in 1958 as neatly as it did the one in 1957, though the two situations bore small resemblance to each other. The automotive industry took a real nosedive last year. At the same time, incoming orders for capital goods rapidly declined. Capital goods demand no longer was a strong pillar holding up the economy. The economy sagged, and especially Metalworking, as a result. The physical volume of metal goods produced in 1958 dropped 20% from the 1957 level.

Recovery from the recession low . . .

set in about the middle of last year. Since then metalworking production has come three-fifths of the way back. How much farther up it will go remains to be seen, but some progress beyond the present point seems assured.

If Metalworking is to prosper as it did a few years ago, there must be full recovery in the demand for capital goods. At this juncture such recovery is not in full view, despite the fact that the nation's production equipment is more obsolete than at any time since World War II.

A recent survey made by AMERICAN MACHINIST shows that production equipment of today's design is, on the average, 54% more productive than that of 1948 design. That metalworking production men are keenly interested in these machines is attested to by the large numbers of inquiries about them. The desire to buy these machines and put them to work in cutting costs, improving quality and boosting output is high. But management refuses to spend the money.

The long time that it takes to recover one's investment, because of archaic tax depreciation rules, is an important reason why management is holding back from acquiring new production equipment. Manufacturers are compelled to abide by the U S tax policy of using excessively long years of service life as the basis for depreciation rates.

Action should be taken . . .

at the current session of Congress to correct this unhealthy situation. The Treasury Department should be authorized to institute the bracket method of depreciation of capital equipment which is working out well in Canada. This method divides production equipment into 10 to 15 broad classifications, with a bracket of reasonable useful lives (with a minimum and maximum) set up for each class. The average depreciable lives should be in the five-to-ten-year bracket. The five-to-ten-year range for write-offs recognizes and makes allowance for rapid changes in technology.

Here then is a practical and potent incentive to get metalworking manufacturers to put to use the newest technology. At the same time Congressional enactment of speedier depreciation legislation would go a long way toward getting the capital goods segment of the economy moving again. Remember that only when the capital goods industry is prosperous does the national economy operate full tilt.

Burnham Finney EDITOR

NEW!
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3/8" Angle Drill . . . Lever Throttle
7/16" Heavy Duty Angle Nutsetter . . . Safety Snap Throttle
1/2" Non-Rev. Drill . . . Grip Throttle
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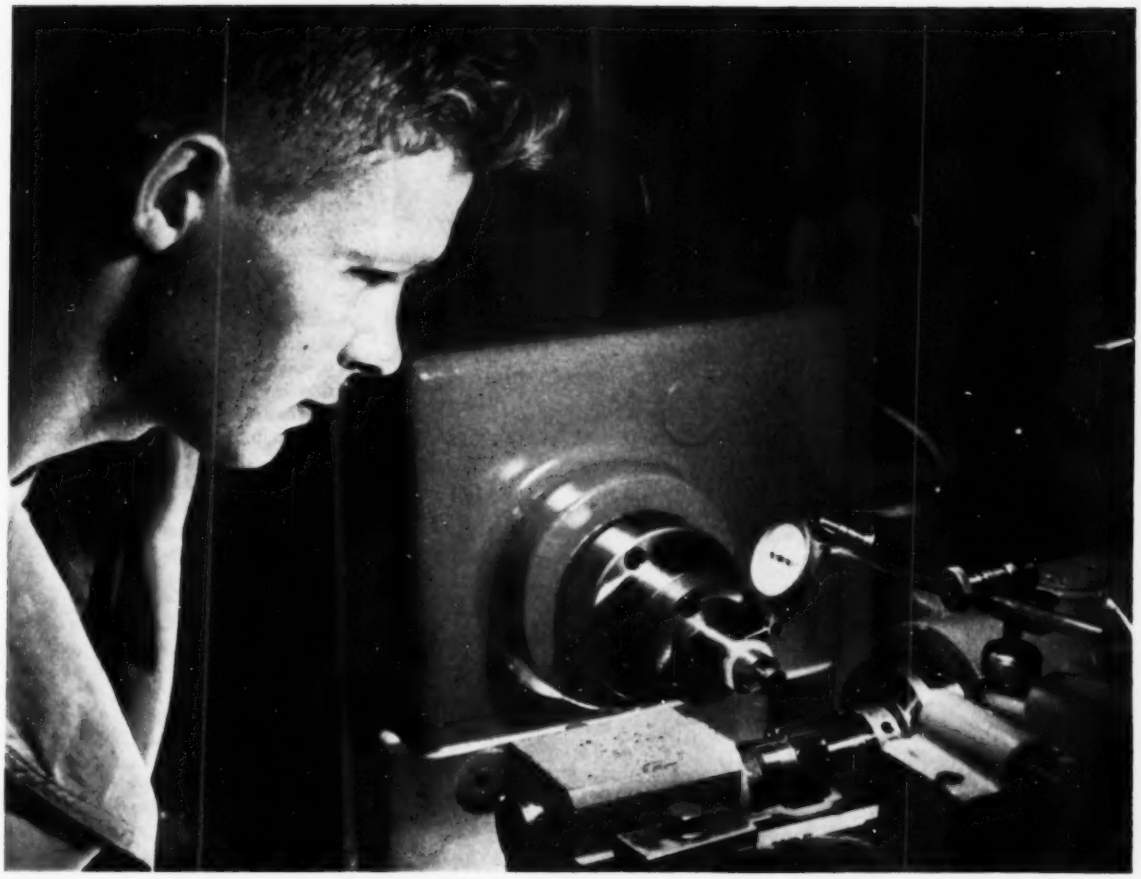
CLEVELAND, OHIO



1 . . . Checking blank for concentricity . . . . . . which must be within 0.0001 in. on this 100-tooth Precision Class 3 gear. Before starting the job, hob is trued to less than 0.0001 in. to assure consistent accuracy

Breaking the COST BARRIER on

Precision 3 gears

Hobbing of AGMA Precision Class 3 gears has long been so difficult, so unpredictable, and generally so expensive that most shops shy away from it like the plague. In fact, such gears have for a long time been "selected" rather than deliberately manufactured. Traditionally, those Class 2 gears that more or less by chance fall within the more precise Class 3 specification have been reclassified. The same upgrading exists between Class 1 and Class 2 gears.

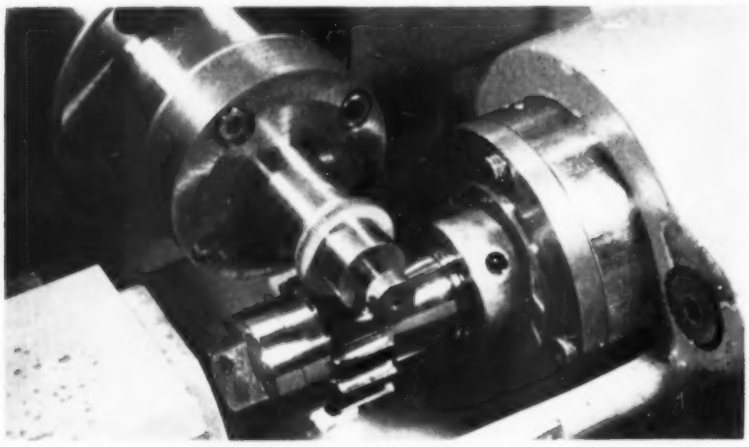
But now, a five-year-old company, PIC Design Corp of East Rockaway, L I, has broken the cost-precision barrier—manufacturing Precision 3 gears on a daily basis, and stocking Precision 1 and 2 gears on its shelves. PIC today lists upwards of 7000 items, from simple gears to magnetic clutches and miniature differentials.

When PIC began precision gear production in 1954, most of its output fell into Class 1, with some Class 2 gears available on special order. Then customers began to demand more and more precision in gears.

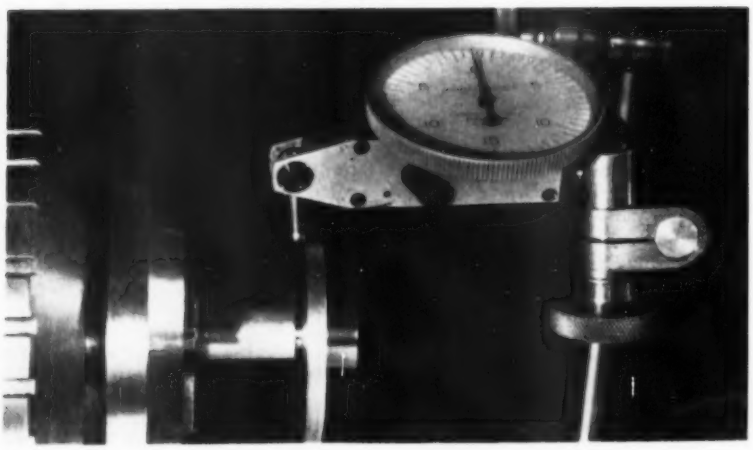
At that time, all the procedural refinements for precision gear production had been developed, but the limiting factor in high output of such gears lay in the hobbing machine itself.

Then PIC engineers got wind that Barber-Colman Co was at work on a hobber, the No. 2½-4, (see Fig. 2) designed to cut Precision Class 2 and 3 gears without segregation or selection. Too, the machine would index accurately within 20 seconds of arc. This meant that on a 2½-in. gear the non-adjacent spacing error caused by the indexing of the machine would be held to less than 0.000122

2 . . . Lineup of Barber-Colman No. 2½-4 hobbers at PIC has been producing Precision 2 and 3 gears since fall of 1958



3 . . . Floating adapters hold tapered arbors on work spindles. Arbors have flats locked with setscrews



4 . . . Inspecting gear blank for face wobble

in. And because of the machine's accuracy, no further finishing, such as grinding or shaving, would be required.

PIC promptly ordered the first four No. 2½-4's to be built, began using them in the fall of 1958, and found the solution to the cost-versus-production problem that had for so long plagued gearmakers.

The machine itself attains the rigidity necessary to high-precision work through a combination of a Meehanite bed casting, welded steel base, and critical shafting that runs on pre-loaded, anti-friction bearings to eliminate end-thrust and wobble.

The heart of a hobbing machine is the indexing gear train, which maintains the timed rotational relationship between the hob and the work—and the No. 2½-4 is guaranteed, as previously mentioned, to index accurately within 20 seconds of arc. The index worm and its mating worm gear are a matched set, and are paired for precision through selective inspection.

Because most PIC-made gears have the same bore, company engineers have been able to design a practical-but-precise set of workholders (Fig. 3). Arbors have slight tapers and are held in floating adapters on work spindles, and they have a flat (for driving purposes) locked with a setscrew. Adjustment is simple: arbors and adapters are floated to obtain desired concentricity.

One of the most sensitive steps in cutting precision gears is preparation of the blank, and only continuous, unrelenting attention to detail can produce the desired accuracy.

For example, all blanks are cut from round bars, rather than from sheet stock. This yields material of more uniform structure, and assures dimensional stability.

Although PIC will make gears from almost any material, it stocks only gears made of Stainless 303 and 24-ST Aluminum. The latter are anodized before hobbing, while stainless gears are clear-passivated after hobbing.

Blanks are turned and faced on a high-speed turning lathe, and bores are finished with a single-point boring tool. Bores are held to +0.0002 in., minus nothing, for size and roundness.

Inspection on a Pratt & Whitney Air-O-Limit (Fig. 4) checks not only bore size but shape, too—cylindrical, bell mouth, taper, etc. After bore inspection the OD is finished to the specific size required for the desired number of teeth.

This is done by mounting the blank on an arbor which has been turned to the exact size of the bore of the blank with 0.002-in. taper. The gear blank (which is mounted on the tapered arbor to insure that the bore runs true) is then inspected for face wobble.

Maximum allowable wobble is 0.0002 in. per inch of diameter. OD when finished must be concentric within 0.0001 in. After the blank has been checked once, it is rotated 180° on the arbor and rechecked.

Best method of determining relative accuracy of fine-pitch gears is to rotate the gear through one complete revolution (in intimate contact with a master gear of known accuracy). With this method, both gears are mounted on a variable-center-distance fixture. The resulting radial displacements (variations in center distance) are then measured while the gear rotates.

After the gears are cut, they are inspected on a Schoppe & Faeser two-flank roll tester (Fig. 5), which measures tooth-to-tooth and total composite errors. Roll diagrams come out of a comparator-recorder attachment. Measuring accuracy is assured and manual interference by the operator is avoided by using an electric motor drive to turn the test gear with the master. The "master gear of known accuracy" in this case is made by INVO, comes with a guarantee that spells out the exact amount of error in the master gear. **Because precision is the rule rather than the exception at PIC, Precision Class 1 gears are not furnished with roll diagrams except on request.** Precision 2 and 3 gears, however, come complete with a PIC "True Blue" gear tape, one per gear, at no extra cost.

One example of Precision Class 2 gearmaking was set up at PIC by truing the hob to within 0.0001 in., and adjusting the tooling so that the blank ran true within 0.0001 in. Gears were produced on the production run within Precision 2 tolerances with no further truing of either the hob or the work.

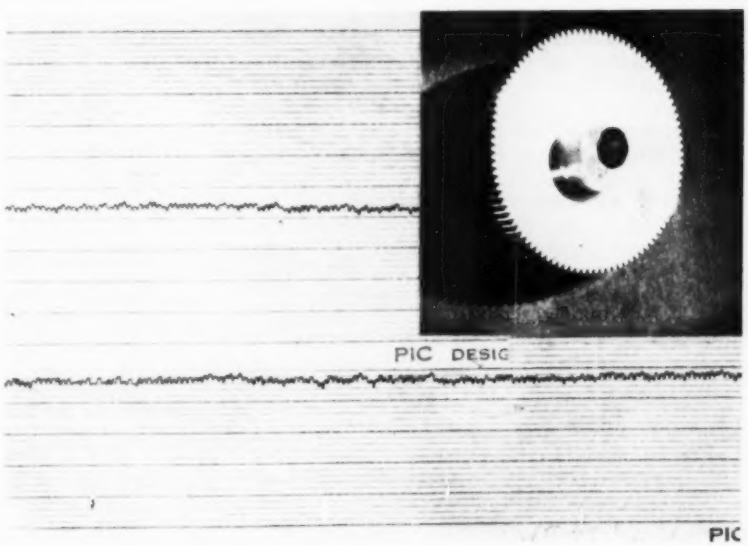
To produce the roll diagram for the gear (Fig. 6) the work was rolled on the gear checker with a master gear, so that the roll diagram would show the aggregate composite error of the work and the master gear.

A second diagram was produced by removing the sample from the checker and placing it in a different position—and the difference between the two charts was negligible.

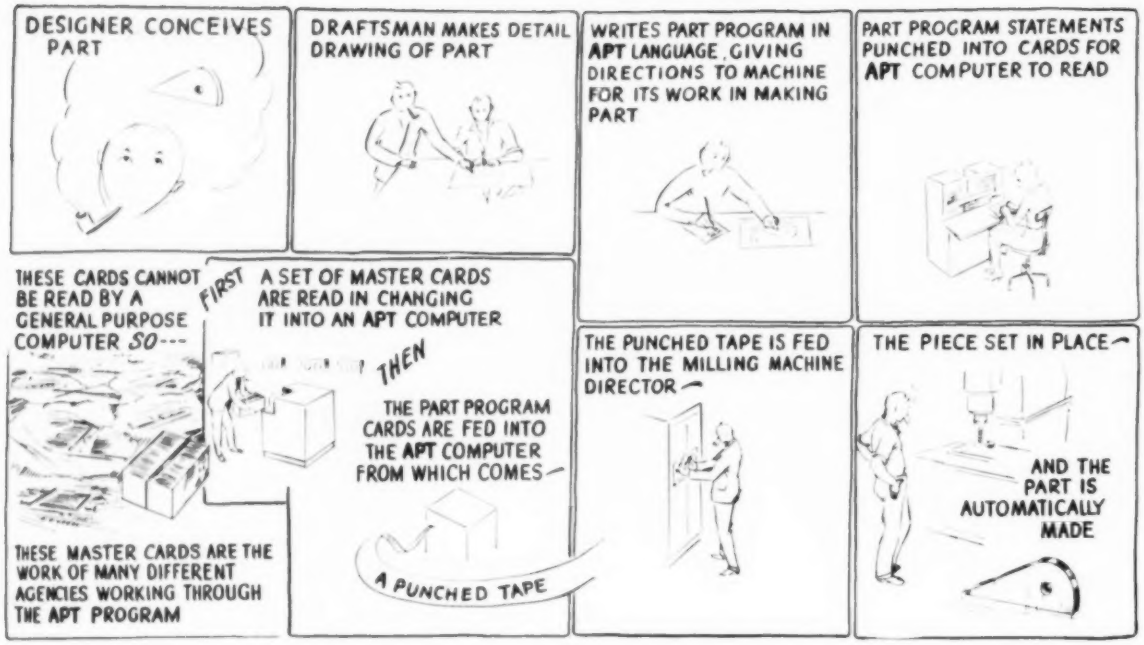
Preparation of the blank for a typical 100-tooth Precision Class 3 gear (Fig. 1) is the same as for the Class 2 gear just described: the difference lies in the hob and mounting of the work.

To assure that it cuts Class 3 gears at all times, the hob is trued to less than 0.0001 in. before the job begins. It is not checked again unless the work starts to fall below Precision 3 specifications. Blanks are all within 0.0001 in. concentricity. When one is mounted, it is inspected for runout, and the arbor is floated on the machine until the blank runs true within 0.0001 in.

5 . . . Inspecting gears on a two-flank roll tester that measures both tooth-to-tooth and composite errors



6 . . . Roll diagrams for a Precision 2 gear


DESIGNER CONCEIVES PART
DRAFTSMAN MAKES DETAIL DRAWING OF PART
WRITES PART PROGRAM IN APT LANGUAGE, GIVING DIRECTIONS TO MACHINE FOR ITS WORK IN MAKING PART
PART PROGRAM STATEMENTS PUNCHED INTO CARDS FOR APT COMPUTER TO READ
THESE CARDS CANNOT BE READ BY A GENERAL PURPOSE COMPUTER SO---
FIRST A SET OF MASTER CARDS ARE READ IN CHANGING IT INTO AN APT COMPUTER
THEN
THE PART PROGRAM CARDS ARE FED INTO THE APT COMPUTER FROM WHICH COMES
A PUNCHED TAPE
THESE MASTER CARDS ARE THE WORK OF MANY DIFFERENT AGENCIES WORKING THROUGH THE APT PROGRAM
THE PUNCHED TAPE IS FED INTO THE MILLING MACHINE DIRECTOR
THE PIECE SET IN PLACE
AND THE PART IS AUTOMATICALLY MADE

APT – The language that commands

"ON KUL, ON SPN, GO RGT, TL LFT, CIRCLE/CTR AT, +2, +3, RADIUS, +5."

The line above is no misprint. It's written in "APT," a language that machine tools can understand. Translation: "Turn on the coolant, turn on the spindle, go right with the tool on the left side along the circle whose center is located at x equals 2, y equals 3, with a radius of 5."

This 107-word, simple (no words of more than six letters) language is the heart of a revolutionary new system which enables a part programmer to write a general outline of a machining sequence by following an engineering drawing. The written-in-APT-language outline is punched onto cards, which feed the problem into a computer that translates the information onto a punched tape, which in turn automatically controls the movements of any machine tool equipped with numerical controls.

APT (for Automatically Programmed Tool) is the end product of two years of intensive research at Massachusetts Institute of Technology. Co-sponsored by the Air Force and Air Materiel Command, APT has enlisted the help of 19 U S aircraft plants.

Basically, APT's advantage over more conventional (if that word can be applied to a science still in its infancy) methods of numerically controlling machine tools is this: elimination of the long hours that a programmer must spend in calculating the moves of a machine tool and in translating them into numerical form to be punched onto a tape.

To metalworking management, APT means this:

- Flexible, accurate and fully automatic production of highly complex parts.
- Large savings in lead-time and final cost of parts.
- A speedup in engineering design.

APT has another decided advantage over conventional numerical control systems in that minor design changes can be made in the computer itself simply by changing one or more master cards. Machine then thinks out the design change and produces a new tape. With conventional N/C setups, design changes must be made all along the line—from designer to machine tool.

In essence, APT works this way:

The designer conceives a part, turns his rough drawing over to a draftsman, who makes a finished drawing. A part programmer, following the drawing, writes a general outline of the machining sequence (see the "ON KUL, ON SPN, GO RGT . . ." sentence at top of page) in APT language.

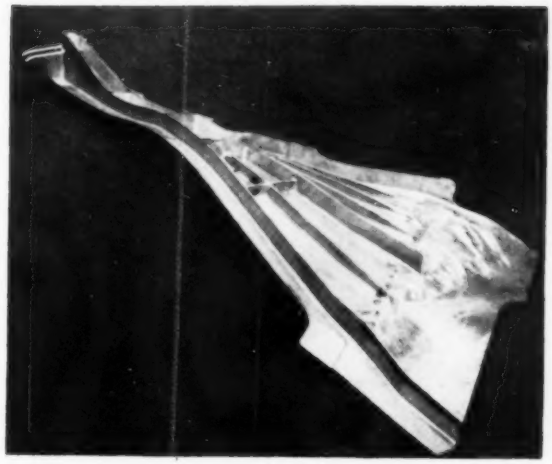
These directions are next punched on cards which are fed into a computer, that "reads-in" a fixed master deck of program cards, then transfers the directions onto a tape that guides the machine tool.

Possible to Program in 3-D

It is possible for an expert part programmer to program in full three dimensions "along any curve which can be defined as the intersection of any two surfaces for which the system contains normal vector and directed distance programs" even though the APT language has not yet reached the point where it applies to 3-D operations.

APT still has some shortcomings. For instance, it does not yet have provision for transformation of coordinates or for automatic cleanout of pockets.

And it will not automatically compensate the effective cutter radius if the entire surface of the cutting tool isn't in contact with the work. But APT does al-



APT would work very well in manufacture of such parts as this complex F-105 wing spar, already being made on a N C spar miller

machine tools

low use of a wide variety of cutter shapes—flat end-mills, ball end-mills, filleted end-mills, and conical cutters—to name just a few.

APT is a continuing project, however. Right now, it's just going into Phase 3. Aircraft Industries Association has just taken it over on a cost-per-member-company basis, welcomes any other company interested in APT to join in.

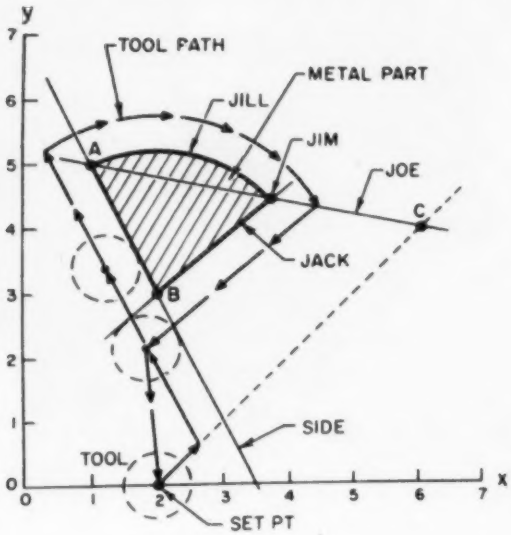
For one thing, APT is being brought down to the level of the smaller company. Currently, IBM 704 computers—equipped with program card decks—are being used on the project. But MIT researchers believe that medium-sized and even small computers, equipped with program card decks, are capable of translating APT language into machine directions with only a moderate loss of flexibility and capability. The program card decks are being made available now through Aircraft Industries Association.

This same get-it-down-to-the-level-of-the-small-company attitude is also being applied to various types of machine tool director systems.

Post-processing and output routines written for Phase 1 of APT fit the equipment of the 19 aircraft companies already in on the APT program, but the routines can be tailored to any other director system—providing someone comes up with a post-processing and output routine that will match the current arithmetical setup. What will come out of the APT Program eventually? For one thing, a U S war machine that "nobody would want to tackle." The words are those of Lieut General Clarence S Irvine, Air Force Deputy Chief of Staff for Materiel, who spoke at APT introductory ceremonies at MIT February 25.

APT will do away with the services of many technicians and machinists, General Irvine said, but at the same time it will create entirely new jobs.

HERE'S THE WAY A DRAWING IS CONVERTED INTO APT LANGUAGE

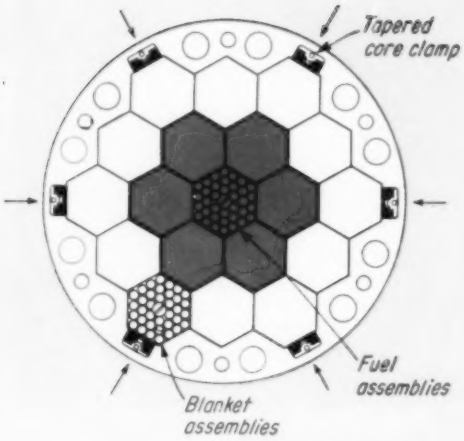



```
A   = POINT / 1, 5
B   = POINT / 2, 3
C   = POINT / 6, 4
      TL DIA / +1.0, INCH
      FEDRAT / 30, IPM
SET PT = FROM, POINT / 2, 0
      IN DIR, POINT / C
SIDE = GO TO, LINE / THRU, A, AND, B
      WITH, TL LFT, GO LFT, ALONG / SIDE
JILL = GO RGT, ALONG, CIRCLE / WITH, CTR AT, B, THRU, A
JOE  = LINE / THRU, A, AND, C
JIM  = POINT / X LARGE, INT OF, JOE, WITH, JILL
JACK = LINE / THRU, JIM, AND, B
      GO RGT, ALONG / JACK, UNTIL, TOOL, PAST, SIDE
      GO TO / SET PT
      STOP, END, FINI
```

KEY: TL=tool, DIA=diameter, FEDRAT=feed rate, IN DIR=in direction, LFT=left, RGT=right, CTR AT=center at, INT OF=intersection of.

A few notes on APT . . .

Designed to minimize computer programming, APT language consists of words with six or fewer letters. Thus the word PLANE represents plane, but a hyperbola is indicated by HYPERB. The 107-word vocabulary is divided into five general categories: geometric names (POINT, PARAB, ELLIPS, etc), motion instructions (FROM GO LFT, GO DELTA, etc), modifiers (TL LEFT, NEAR, FAR, CUT), parameters (TOLER, CR DIA, TL RAD), and miscellaneous words such as IN DIR, CTR, Z PLANE, MAX DP, WITH, ALONG. The latter two words, incidentally, are optional and are included only to aid readability.



Reactor-core tubes must be straight so they can be removed and replaced when necessary (left). The 19 stainless steel tubes in Mark III core of EBR-1 reactor are accurately fabricated to hold fuel and blanket assemblies in proper relation

Precision hex tubes require special techniques

Experienced tube makers recognized a tough job when they saw it. They didn't want to tackle this difficult assignment in thin stainless steel, so Argonne developed its own tooling and techniques to do the job

By Herbert V Ross, superintendent,
and Alexander A Denst, general foreman,
Central Shops Department, Argonne National Laboratory, Lemont, Ill

When you can't buy it, you've *got* to build it. That's the situation Argonne National Laboratory was up against when it had to have some special hexagonal tubes for the core of the EBR-1 experimental reactor.

In spite of the fact that these thin-walled stainless tubes were 10 ft long, they had to be so straight that any individual tube could slide up out of the core for replacement without damaging itself or any of the others. When clamped together in a rigid assembly, they had to fit snugly and with minimum distortion from their true geometric shape.

Made of 0.043-in.-thick stainless steel (Type 304), they were only 2.875 ±0.005 in. across flats, and the internal radius at each corner was held to a maximum of 0.062 in. Here are the other manufacturing tolerances:

1. Sides flat within 0.005 in. concave or convex.

2. Deviation from 120° angle between adjacent sides not to exceed 0.005 in. at opposite corner (approx 1°).

3. Twist held within 0.015 in. per 36 in. of length, 0.045 in. in 10 ft.

4. Longitudinal straightness held within 0.015 in. in any 36 in. of length.

Because these tolerances are much closer than normal for commercial tubes, only one company, a foreign one, was willing to attempt the job, so a contract was let to them.

However, the program was urgent. In addition, tests made at Argonne's shops had yielded promising results, so the Central Shops Dept went ahead and started fabricating a supply of tubes without waiting for delivery from the contractor. This was a fortunate decision. When the contractor delivered the tubes, they did not meet the required tolerances.

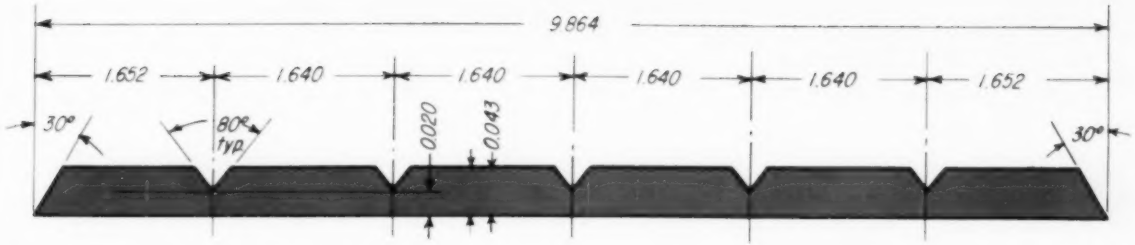
We decided to fabricate our tubes from sheet stock (commercially rolled and selected to 0.043 ±0.0005 in.) and weld the longitudinal seams. Commercial seamless tubes could not be sized with sufficient accuracy.

Then, we had a problem in holding the internal corners to the specified size while forming the required 120° angles at the tube corners. We solved it, though, by scoring and chamfering the sheets longitudinally to precise dimensions.

Our procedure was to shear the 10-ft-long sheets to a width of 9.937 in. and then clamp them individually to a flat fixture plate on an accurate planer. The sides were chamfered to a 30° angle to reduce the width to 9.864 in. Then, 5 longitudinal grooves were cut 0.020 in. deep with an 80° included angle. For each cut, the saddle was positioned on the planer cross rail with precision gage blocks to insure accurate location of the grooves: 1.640-in. centers starting 1.652 in. from each side.

Next, the individual sheets were formed into hexagonal tubes in a

Argonne National Laboratory is operated by the University of Chicago for the US Atomic Energy Commission.



Sheets are grooved before being formed . . .
into hex tubes. Notch is permissible because of low pressures, little vibration, in reactor. Other applications might require a weld at each corner

press brake with accurately aligned conventional tools.

Welding of the longitudinal seams was performed in a standard draw bench with a helium-shielded welding torch. The bench was equipped with a special 10-ft-long fixture base and a 12-in.-long welding cap, the two pieces accurately machined to form a hexagonal bore. Inside this bore was a hexagonal welding mandrel made of aluminum bronze.

The tube was attached to a special draw rod by small pins inserted through holes punched in the tube walls. As the draw rod pulled the tube over the mandrel and through the hexagonal bore, the open seam in the tube passed under an opening in the cap where the Heliarc torch was centered.

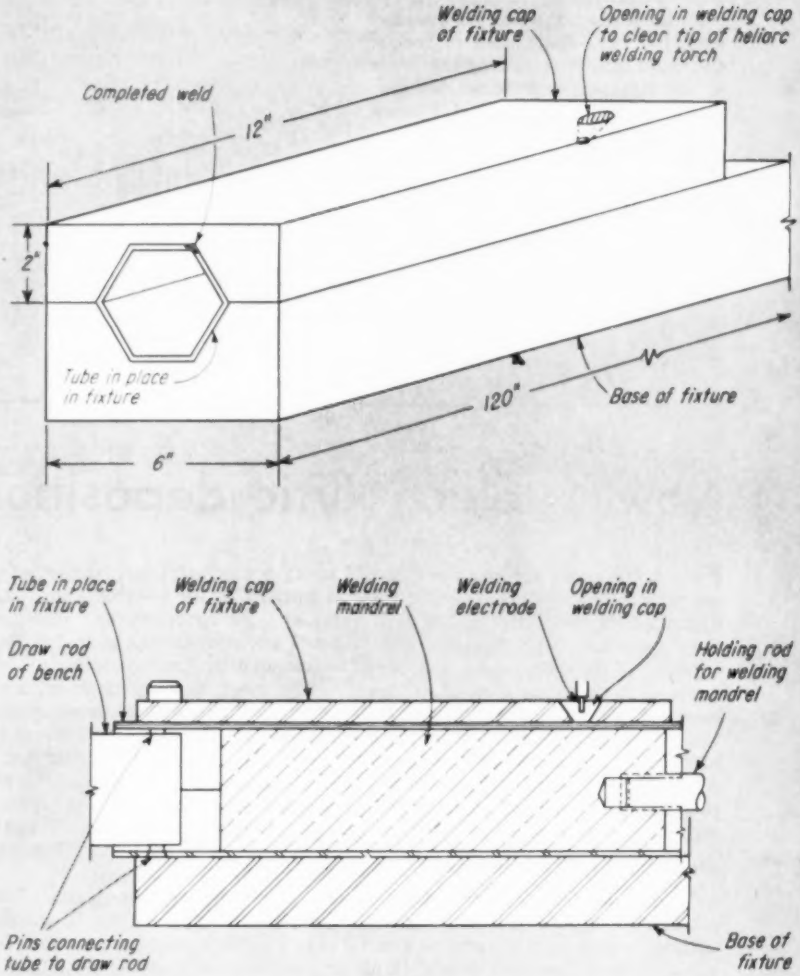
Cleaning before welding consisted of wiping the edges of the tube seam with clean stainless-steel wool and then swabbing them, first with acetone and then with alcohol. The welding torch had a 1/32-in.-dia tungsten electrode and was powered by a d-c, rectifier-type welding machine. At 15 ipm, the total welding time was 8 min per tube.

Tubes were sized carefully

After the welding operation the tubes were sized, first externally and then internally. Sizing did not reduce the wall thickness of the tubes but served the purposes of cold working the welded area and insuring dimensional accuracy.

When a set of tubes had been welded, the short welding cap was removed from the fixture, and a 10-ft-long sizing cap was mounted in its place. This fixture then guided the tubes while the draw rod pulled them through a sectional, hexagonal sizing die at about 48 ipm.

The six mating sections of the die were made of high-chrome die steel, were hardened to 60-63 R_c, then ground all over. Shape of the throat in the assembled die, including the



Tubes are welded in versatile fixture mounted on draw bench. Mandrel is made of aluminum bronze, and welding cap is lined with same material to draw heat away from weld area as rapidly as possible. When welding is completed, the 12-in. welding cap is replaced with 10-ft cap for external sizing and internal burnishing

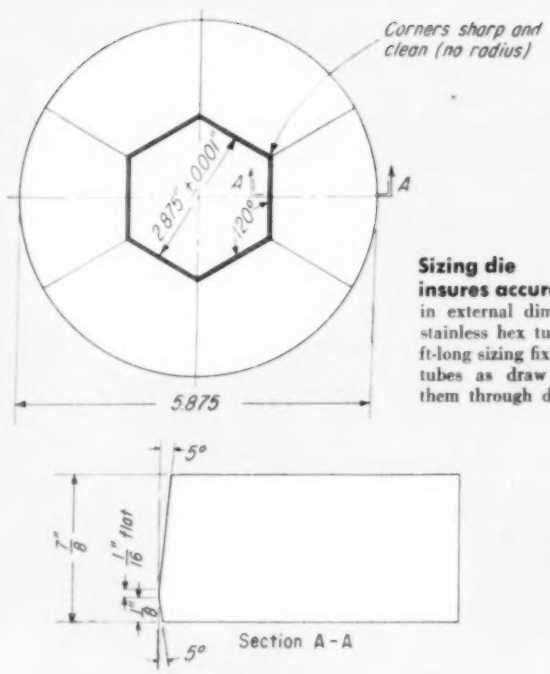
Precision hex tubes . . .

5° entry and relief angles and the 1/16-in.-wide land, was important to the success of this operation.

Finally, for internal burnishing, each tube was again placed in the sizing fixture, and the sizing cap was tightened to lock the workpiece in place. Then the draw rod pulled a 10-in.-long burnishing mandrel through the tube at about 48 ipm.

The mandrel had three 1/16-in. lands spaced 5 in. apart. All the lands were finished accurately to the same size across flats to eliminate the possibility of the mandrel twisting as it was pulled through the bore of the tubes.

Both the draw die and the mandrel were hard chrome plated to reduce wear and minimize galling the walls of the stainless-steel tubes. To further reduce galling, a special lubricant suggested by Elliot Zeiss of the Central Shops Dept was made by dissolving Lucite acrylic plastic in ethylene dichloride and benzine. This quick-drying fluid was swabbed on the tools and the tubes with a paint brush, then allowed to dry thoroughly before the operation was performed.



Sizing die insures accuracy . . . in external dimensions of stainless hex tubes. A 10-ft-long sizing fixture guides tubes as draw rod pulls them through die

Now . . . electrolytic deposition of molds

Permanent and expendable molds are now being made by electrolytic deposition at Emmco Pty Ltd, Sydney, Australia. The invention, according to its developers, has been devised to "provide a mold of low heat capacity, good heat conductivity, permeability to gas and precision of surface detail"—a collection of desirable properties the Emmco people claim have not been available in any single mold to date.

Claim Superior Properties

They point out, for instance, that sand molds have high heat capacity, inferior conductivity, and do not achieve good surface detail. Sand shell molds have a slightly inferior heat conductivity, achieve slightly better surface finish. Bonded refractory molds have high heat capacity and inferior heat conductivity, and permanent metal molds have no gas permeability. The new method is claimed to solve all these problems.

In essence, a metal shell mold of microscopic or sub-microscopic porosity is electrolytically deposited on a pattern in an electroplating bath, which incorporates an insoluble, inert material in fine granular form suspended in the electrolyte.

The inert material flows with the metal ions, creating desired porosity in the metal that is deposited on the mold. The shell mold so formed is then removed from the pattern and attached to or supported with a permeable backing material (metal shot, sand or other material capable of fast heat distribution).

Next, a parting compound (wax, grease or oil) is applied to the pattern's surface. Pattern then goes into a conventional electroplating bath, to which a fine suspension of an inert and insoluble material (clay or graphite) has been added in quantity determined by the desired degree of porosity.

Pattern is then connected to the negative pole of a direct current supply, while the positive is connected to a conventional soluble or inert anode immersed in the bath. Bath is agitated by air or mechanical means.

Current is applied. Metal ions from the plating bath mix with the suspended material, are deposited over the pattern as a porous shell. Metal deposition continues long enough to allow the shell to build up to required thickness in excess of 1/1000th of an inch, then the shell is stripped from the pattern, and the same procedure is carried out with the other pattern half.

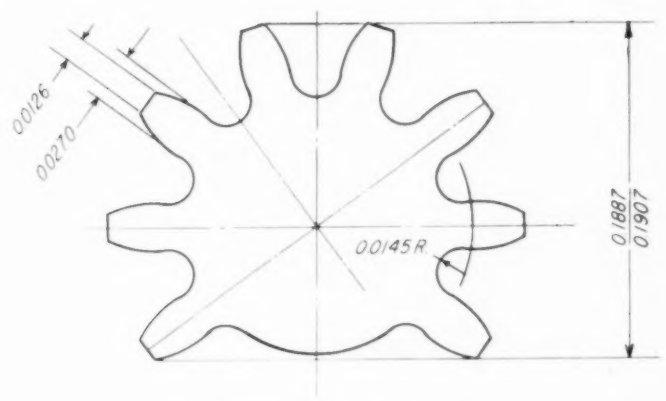
Inside surface of the shell is treated with a conventional dressing compound. The shells are then clamped and backed with a permeable backing material, and the mold is ready.

Emmco, which has patented the process in Australia, has found that ions of nickel, cobalt, iron, copper, or a combination of such metals work well in a bath which contains, in addition to an inert material, anions selected from chloride, sulphate, fluoborate, phosphate, sulphamate, pyrophosphate, borate or fluoride.

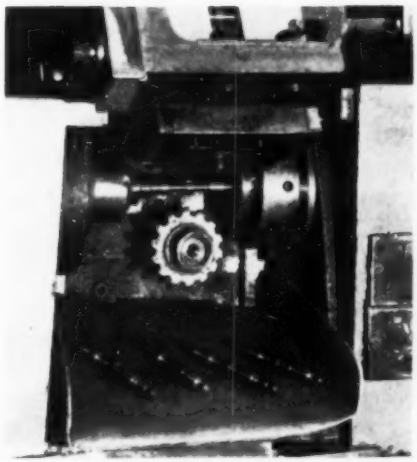
"We made these machines ourselves"

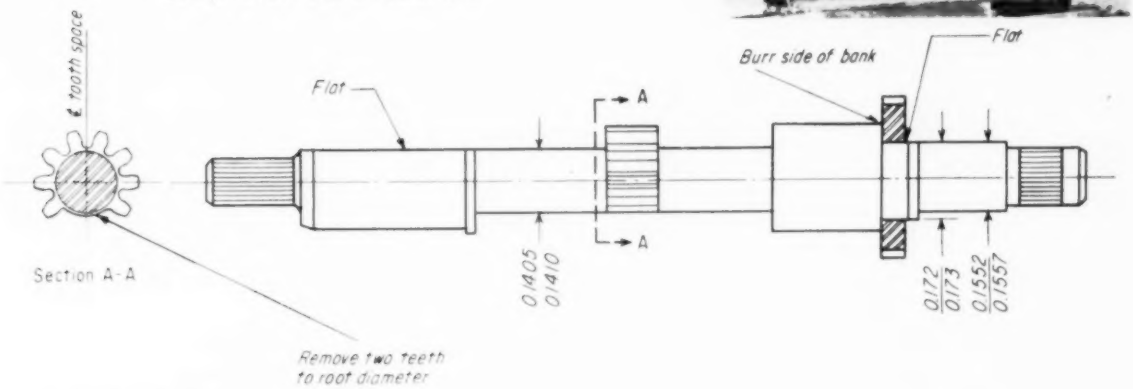
Here are five "home made" machines, each designed and built by Friden Inc, San Leandro, Calif, to do a highly specialized job. Simplicity is the keynote of these machines—all non-essential elements have been eliminated. Because they are tailor-made to a specific job, these machines have cut costs, improved product design . . . and they allow Friden wide latitude in designing office machines

1 . . . Automatic gear cutting on slender shafts



Enlarged View of Gear at Section A-A

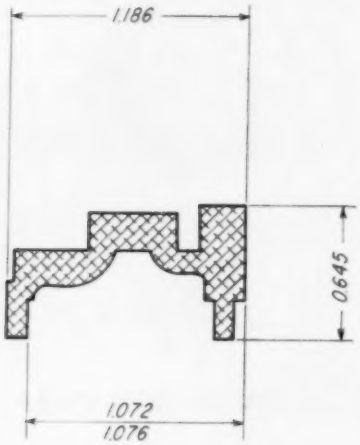




Slender shafts are supported . . .

. . . during this gear-cutting operation at Friden by two opposed 10-tooth involute cutters. Each shaft is fed from a magazine into the collet shown at left in photo. Collet then retracts and positions the shaft for cutting. Two cutters (tip of the upper cutter is just visible over the shaft in the photograph) are advanced and retracted by cam action—so that the lower cutter cuts the first and second teeth as the upper cutter mills the fifth and sixth. Held by collets, the shaft is automatically indexed for each cut by a slight oscillating motion. When 10 teeth have been produced, two are removed down to the root diameter in the same cycle. Automatic ejection follows

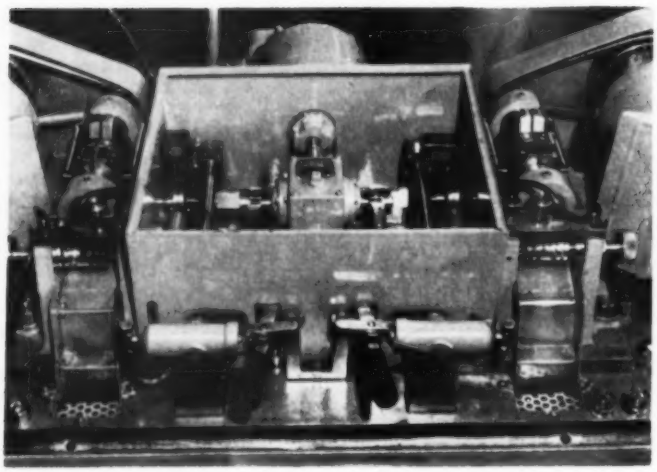
2 . . . Friden-designed machines mill and drill

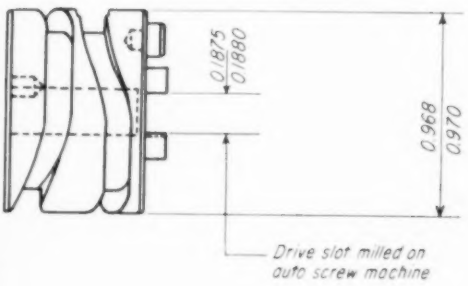


Half the number of cutters . . .

. . . formerly required are used in this special Friden-designed gang milling setup. Two each of two different extruded aluminum carriage rails for calculating machines (see drawings) are contour-milled top and bottom to produce a complete set (one front and one rear rail) with each cycle. The fixture and special cutters are installed on a standard Cincinnati horizontal milling machine. Stronger cutters (see photo above left)—wider and more stable than conventional tools—are obtained by combining 11 carbide-tipped blanks to replace individual cutters for 21 separate operations. Spacing between cutters is accurate, easy to maintain. Results: less setup time, reduced cutter maintenance, high work quality, fewer machining problems

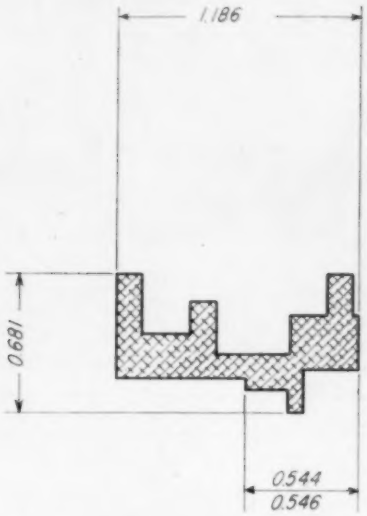
3 . . . Two-machines-in-one cut cam-milling time

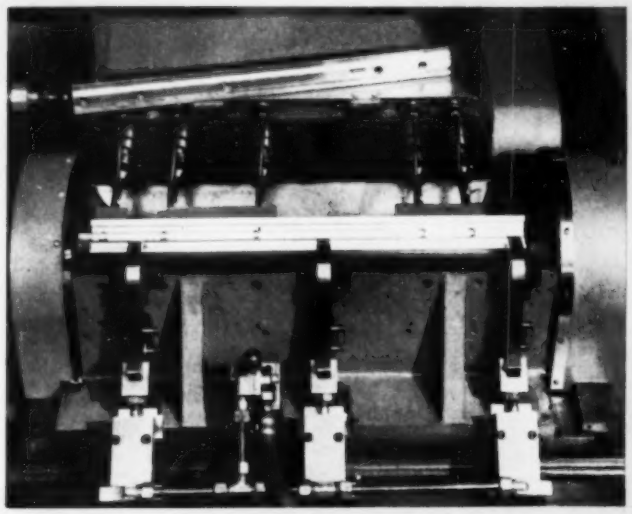




Two close-tolerance cam races are produced one at a time on 1-in.-dia phosphor-bronze blanks in this setup designed and built by Friden. A master cam at each of two independent stations controls the movement of a blank in contact with a stationary 0.127 in.-dia, two-lipped carbide-tipped end mill. While the first track is being cut, a second blank is manually loaded. Upon completion of the first track, the blank is manually indexed for cutting the second. Gear box between the two stations controls the feed of the work to the cutter. A cast Meehanite base supports the heads—a standard feature of all these machines designed and built by Friden engineers

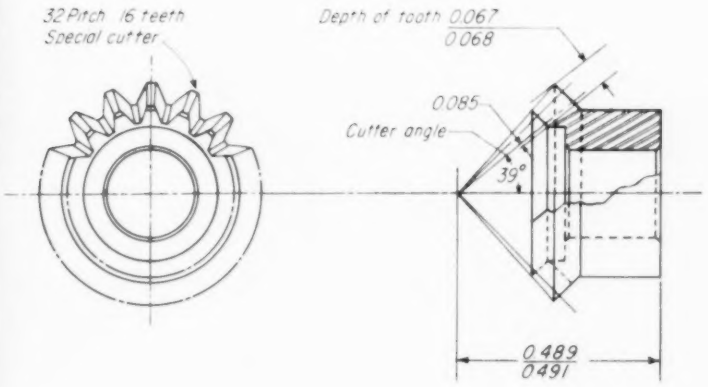
calculating machine carriage rails





Automatic five-spindle drilling machine . . .
. . . was designed by Friden's engineers to produce five 0.358-in.-dia holes through carriage rails. Non-accumulative location tolerances are held within 0.002 in. Air-operated clamps lock parts in the fixture for cam-actuated feed to the drills. Three mechanical fingers hold them in place during drilling. Easy to clean and load, this simple machine was designed for no more than the job at hand. Maintenance costs are low, production rates are high, and only a small amount of floor space is required for the entire setup

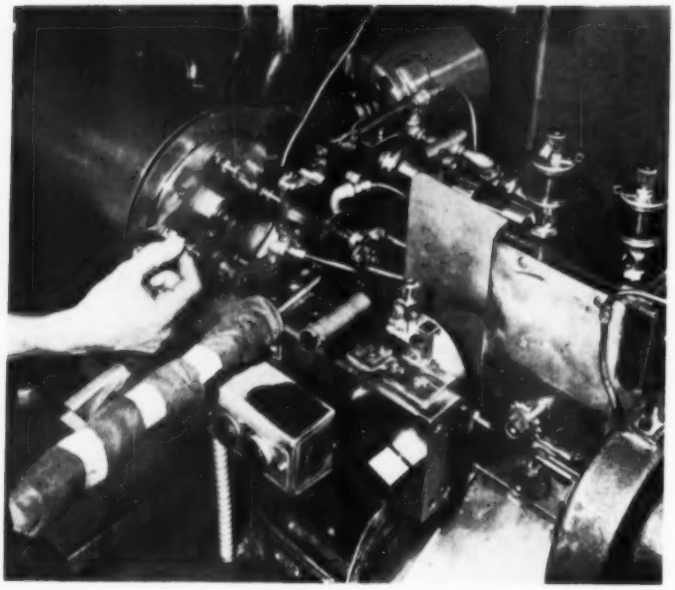
4 . . . Standard hand mill now cuts bevel gears

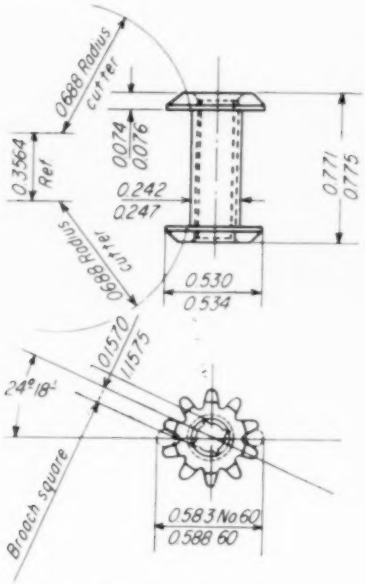


Friden engineers have modified this standard hand mill to cut bevel gears at high production rates. Air-hydraulic cylinders make the operation automatic. Power-driven table is synchronized with automatic indexing of the gear blank —so that one tooth is cut with each pass. Angular indexing head accommodates gear geometry in this simple setup, which combines 100% inspection with an extremely high rate of production

"We made these machines ourselves" . . .

5 . . . This home-made machine performs several jobs





Multiple operations are performed in this Friden-built machine. Screw-machined gear blanks are manually loaded into a vertically indexing head in the center. A 90-degree index carries a blank to two vertically opposed gear cutters (shown at right in photo) which cut both ends of the blank (top and bottom) simultaneously. In this way two teeth are produced on each end at once. Horizontal indexing is automatic, until all the teeth are cut. Then the gears are manually loaded into the skiving head at right. Here, the spool diameter and burrs are removed from the teeth with a flat form tool. Ejection of the completed parts is automatic

Air clamps cut wing beam profiling time 40%

It's now taking 40% less time to profile heavy aircraft wing beams at Chance Vought Aircraft, Dallas—simply because air clamping has taken the place of manual clamping.

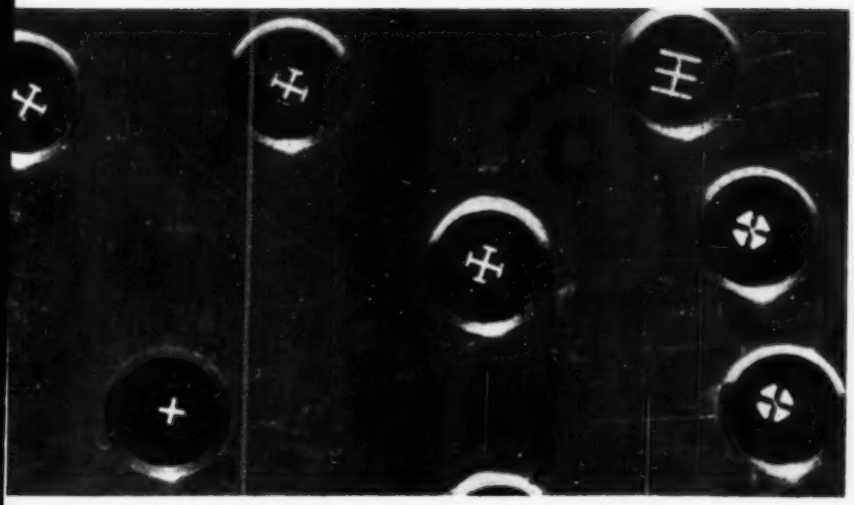
Wrench-tightened clamps formerly held the 200-lb forgings in place for profiling by a Keller three-spindle machine. But now Chance Vought has come up with a system of air clamps operated by five air valves that allows the operator to move any of the 17 air clamps involved without stopping the operation.

The tool matches the inboard, outboard upper and lower surfaces of the left and right hand beams. In this way, only the templet needs to be changed, and there is no need to employ a left and right hand tool.

The clamping system is designed into the machine, so that the complete unit can be easily moved to allow milling of other parts. It is operated by a two-way air cylinder using standard shop line pressure of 90 to 100 psi.

Each wing beam on the Keller machine has its own set of clamps and levers. Each handle is painted a different color, so that it can easily be identified

Closeup of a forging in the Keller profiler. Clamps in foreground have been rotated to permit milling in that area



Cuts made by a beam of electrons (left) . . . The narrow slots are 0.0015 in. wide, 0.018 in. deep at bottom of counterdrilled holes. Discs are "spinnerettes"—nylon extrusion dies. Power for cuts was 100,000 v—0.5 to 1.0 milliamp

In less than a year we've seen

• Welding • Coating • Melting

AND NOW . . .

Electron beam MACHINING!

By Richard T Berg, assistant editor

Almost daily, new uses are being found for metalworking's hottest new tool—the electron beam. Already reported are welding and melting; rumored is metal deposition. And now: machining.

West Germany's Carl Zeiss has come up with electron beam equipment capable of cutting a clean-edged slot or hole through the toughest materials to a slot width of 0.0015 in. or even less. With tape control, it cuts extremely accurate, intricate profiles. And there's no cutting tool, therefore no tool wear.

The cutting unit operates on the same principle as the electron beam welder (*AM*—Feb 23, '59, p95)—but it focuses the beam into a much smaller spot. Too, it raises the energy concentration to a level that *vaporizes* the work material. (Welding merely *melts* it).

Electron beam cutting and welding are both offshoots of the electron microscope. But while beam welding was the first metalworking development to be reported, electron-beam cutting has actually been done on a production basis for over a year at Zeiss—piercing bearing jewels for instruments. Even in these hard synthetic sapphires, the beam vaporizes holes as small as 0.001 in. in dia.

At the moment, there are still no electron-beam cutting machines at work in the United States. But the U S representative for Zeiss's electron beam devices (Electrona, Inc, 40 Wall St, New York City) says it has orders from duPont, Chemstrand, and L R Industries. Main application: drilling the tiny patterns in spinnerettes and other micro-miniature work such as injection nozzles.

In both the welding and cutting machines, electrons are emitted from a heated tungsten filament into a beam-forming cup at the top of the machine. This cathode system operates on a negative dc voltage with respect to the ground, regulated steplessly from 25 to 125 kilovolts. The bias potential on the cup is adjusted from 0 to 1000 volts.

A couple of inches below the cup is a grounded anode ring. The electrons hurtle through this ring and down toward the workpiece at velocities ranging up to 102,000 miles per sec.

As they go, they are aligned by two sets of four electromagnetic coils. Lower in the column, an electromagnetic lens brings the beam into focus for the work it has to do.

And here, in the focusing lens, is the major difference between the welding and cutting machines. The cutting machine has a stigmator control which focuses the beam to a much smaller diameter than would be required for welding.

Here's an indication of how fine the focus can be: in experimental

work the equipment has drilled a hole only one micron in dia. That's only 39 millionths of an inch, and normally, the beam diameter is half the diameter of the hole it drills.

But, while the beam is being focused into a small area, energy, too, is being focused and concentrated. Therefore, for the smaller holes and slots, lower power settings are employed.

Operating temperatures up to about 11,000 F have been employed. Presumably, higher levels are attainable with a greater power input. However, this temperature has been adequate for any welding, drilling, or cutting the equipment has been called upon to perform.

High-temperature effects

High temperatures naturally bring up the question of what happens to the metal adjacent to the cut. In any sort of heat cutting, some of the metal in this zone will be raised above the transition point and will cool in a crystallized cast structure.

Electron-beam cutting does not escape the problem entirely, but according to Electrona, the width of the heat-affected zone is held to about 10% of the width of the cut.

The "secret" is in a pulsed beam that bombards the workpiece intermittently and therefore holds down the temperature rise in the surrounding metal. The pulse generator operates at any desired frequency from 1 to 3000 cps, with pulse durations of 0.01 to 0.000,05 sec.

Instantaneous Vaporization

When the beam is controlled by the pulser, the work is subjected to short bursts of electrons that almost instantaneously vaporize the workpiece in the small area where they strike. Much of the heat is thus carried away by the vaporized metal.

Then, as the beam is "off" much longer than it is "on", the work has a chance to cool before the next burst. Admittedly, the cooling-off period is short, but it does keep the heat from building up and from traveling more than a short distance into the remaining metal.

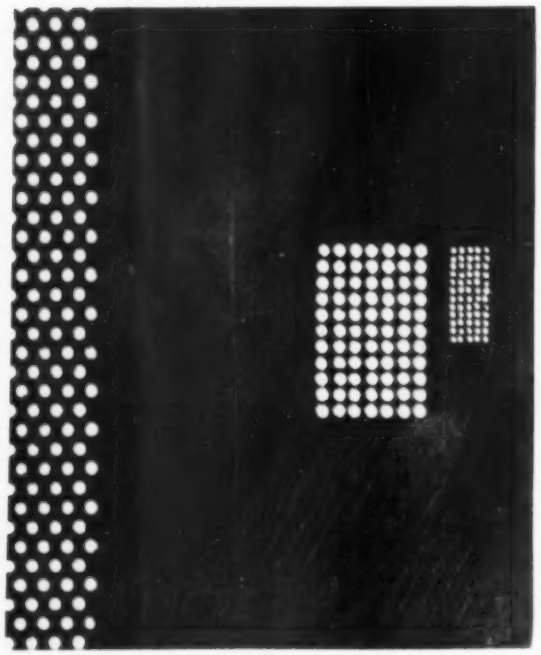
The depth of cut with the present equipment has ranged up to ¼ in. Width of cut is much smaller, because the beam has to be highly concentrated. However, width is not a significant factor. If you wanted a slot, 2 in. long by ⅜ in. wide, you would trace the outline of the slot and let the material drop out of the middle.

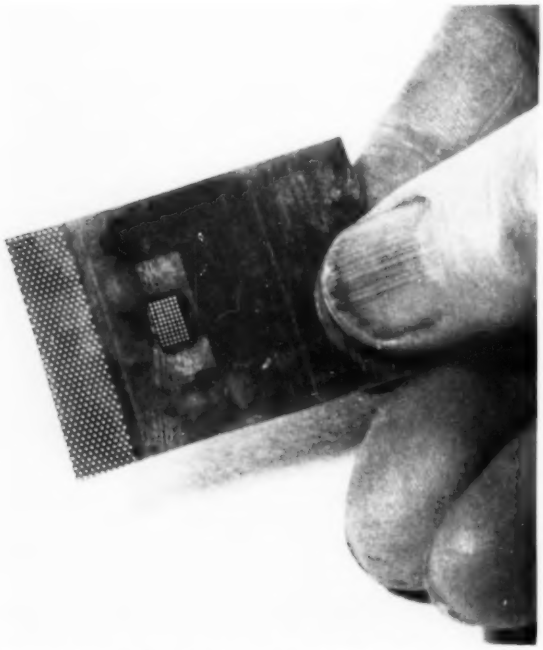
For most cutting, the beam is adjusted to make a straight-sided cut as it passes through the work. However, a unique feature of the equipment is that the beam can be intentionally focused to converge sharply to a point at the bottom of the workpiece. In drilling a hole, this arrangement would produce a cone-shaped hole with the apex at the bottom. Employing the same principle, the work can be traversed, and the beam will cut a V-shaped slot with the apex at the top or the bottom of the piece as desired.

Will cut to depth

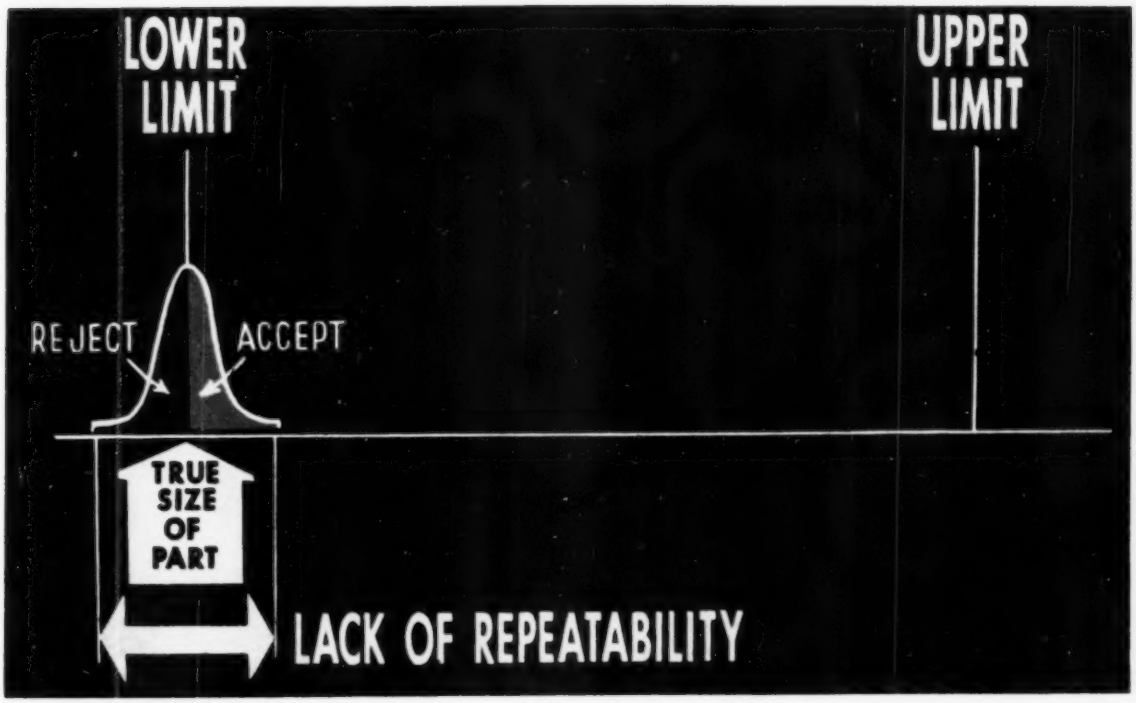
Normally, a cut is made clear through the work, but bottoming cuts or holes are also possible. Unlike the conventional gas cutting torch that does some of its work by melting the metal and then pushing it out of the way, the electron beam actually vaporizes the metal—boils it off. Therefore, with proper adjustment of all the variables—power input, pulsation rate, beam concentration, and traverse speed or length of dwell—the depth of cut can be precisely controlled.

Electrona claims the equipment will be doing three-dimensional machining in the near future. Magnetic tape will control the number of impulses directed at each minute section of the work.





Color TV grid (left) was etched . . .
Middle grid was cut with electron beam. Holes are same size (0.014 in.), but land between them is only 0.005 in. Holes at right, also electron-drilled, are 0.005 in. in dia with 0.005-in. land



Lack of repeatability . . . in a properly calibrated gage may result in rejecting half of the parts that have a true size right at the tolerance limit

Let's take the guesswork out of inspection!

The thin gray line between acceptance or rejection of a part that borders perilously close on tolerance limits has long given inspection departments a headache. And in this era of increasingly close tolerances, decisions will become harder and harder to make.

Is there, then, a simple practical method of drawing the line between acceptance and rejection of such parts? GE-Evendale thinks it has found one. But first let's look at the problems involved:

By Jack S Gantt, supervi-or of quality engineering
Jet Engine Dept. Aircraft Gas Turbine Div. General Electric Co. Evendale, Ohio

The inspector is the "man in the middle" in a perennial battle between engineers and shop people. It's the fond belief of the engineer or draftsman that when he puts tolerance limits on a drawing, inspection will reject all parts that fall outside those limits.

But it's the equally fond belief of the shop man that any part he produces within the drawing limits ought to pass inspection—even though that part is on the high or low side of the tolerance mean.

The inspector also has a delusion or two of his own. Most common of these is that he just *knows* from long experience if a part is acceptable even though its true dimension is just within specified limits, or if it should be rejected because it's just outside acceptable limits.

Its not that easy.

Why? For one thing there's accuracy of inspection instruments to be considered—the possibility of some gage bias in every measuring device, enough to shift the location of tolerance limits away from true values.

And lack of repeatability is a very real problem. Is it possible to get exactly the same reading on the same part if remeasuring is done repeatedly with the same measuring device? Not very often. Remeasuring with a different gage compounds the error, because of differences in calibration.

If a part's true dimension falls into the middle of the tolerance spread, its rejection is unlikely—assuming that measurement repeatability and bias constitute a small percentage of the spread. But what if the part is right on the tolerance limit? Even with a perfectly calibrated gage, lack of repeatability may result in acceptance only half the time.

Reasonable Limits

Certainly, gages that always produce the same decision on repeat measurements reduce tolerance limit uncertainties—but they're prohibitively expensive. It's far more practical to recognize repeatability and calibration bias and to establish reasonable limits for them.

Admittedly, this does create a "gray area" in which a part outside the limits may be accepted, or in which a part that is inside the limits may be rejected. Thus the engineer will have to expect to get some parts

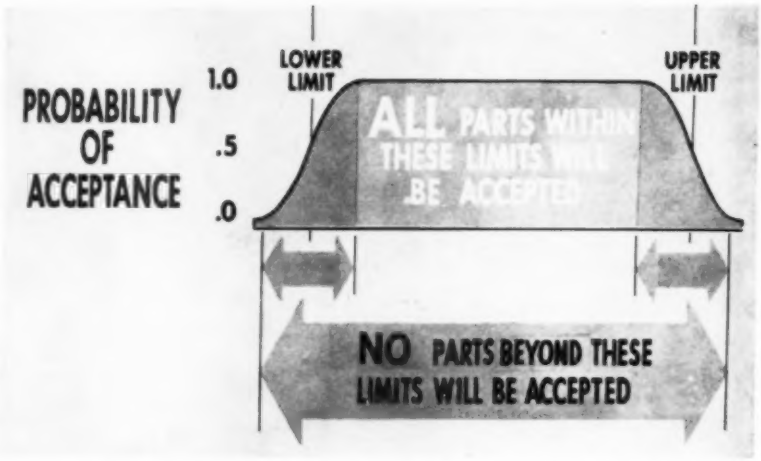
that fall outside specification limits, even though they were inspected and passed as satisfactory.

By the same token, manufacturing people must expect rejection of some parts with dimensions inside the tolerance limit. In effect, manufacturing must use process limits that are tighter than blueprint limits so as to avoid rejection of parts thought to be within limits.

The effect of measurement repeatability can be shown graphically. If its relationship to tolerance limits is known, an "operating characteristic curve" can be plotted to determine the probability of acceptance of a given part. For example, if measurement repeatability is 5 or 10% of the tolerance spread, the area of uncertainty will form a small band about the tolerance limits. In the middle of the specification is 100% probability of acceptance.

But when measurement repeatability is poor—when it becomes a large percentage of the tolerance spread—it's possible that parts far outside of blueprint tolerances might be accepted. On the other hand, perfect parts with dimensions right in the middle of the specification stand some chance of being rejected.

How can a practical limit be put on the discrepancy between measurement uncertainty and specifications? One way to do it is by compromise. Say a limit of 10% of total tolerance spread is allowed for gage repeatability. This spread is figured on a 99% basis, i.e., the spread would include 99% of the readings on a single part to determine the repeatability of the gage.



Operating characteristic curve . . . shows that for repeatability in the order of 5 to 10% of the tolerance spread, the area of uncertainty is relatively small

Need Simple Test

To be effective, this test must be simple and practical, require no high-level technical people. In other words, if the test can be applied by people inexperienced in statistical analysis, so much the better.

When two or more gages are employed in the same inspection, calibration bias between them must be compared and limited. GE-Evendale sets the limit at 4% of the tolerance spread.

Gage repeatability may be estimated in a number of ways. The method selected by GE-Evendale is a technique known to the quality control engineer as the d_2 conversion from $\overline{R}$. Here's why:

- Calculations can readily be made by inspection personnel.
- The gage can be tried under varying conditions (change of operators and parts) to obtain a more accurate measure of repeatability, overall performance, and operator bias.
- Data can be retained for further analysis and diagnosis of the source of difficulties.
- Obvious errors in measurement can be isolated, so that they will not influence the repeatability estimate.

Simple Form

To make the test a routine one, we designed a form (reproduced here). Three operators measure ten different parts twice each, with the same gage, to estimate gage repeatability. To estimate gage bias, one operator measures each of ten different parts twice for each of the different gages.

These procedures enable us to compare calibration bias of one gage with that of another. A non-technical person can make these estimates; all he needs is an ordinary ability to handle arithmetic. We provide simple scales to make multiplying and dividing easy.

Sometimes it's impractical to obtain ten completely different parts. Here we may compromise, although our objective is to get, whenever practical, a measure of the gage's performance over a variety of parts.

We prefer that the operators who run this test be those who normally use the gage in production. In this way we can find out whether the measuring device has peculiarities that make it susceptible to operator bias and operator errors.

Entries at the top of the form identify the tool or gage under test. The 10 parts selected are listed in the column headed "Part Serial Number." Our first operator, Smith (Operator A), measures each of the 10 parts with the gage, and each of his values for each part are recorded as his first set of readings.

We then ask McKinney (Operator B) to measure the same 10 parts with the same gage, and to record these values in column 4 as his first readings. Next Berry (Operator C) measures and records his ten readings in column 7.

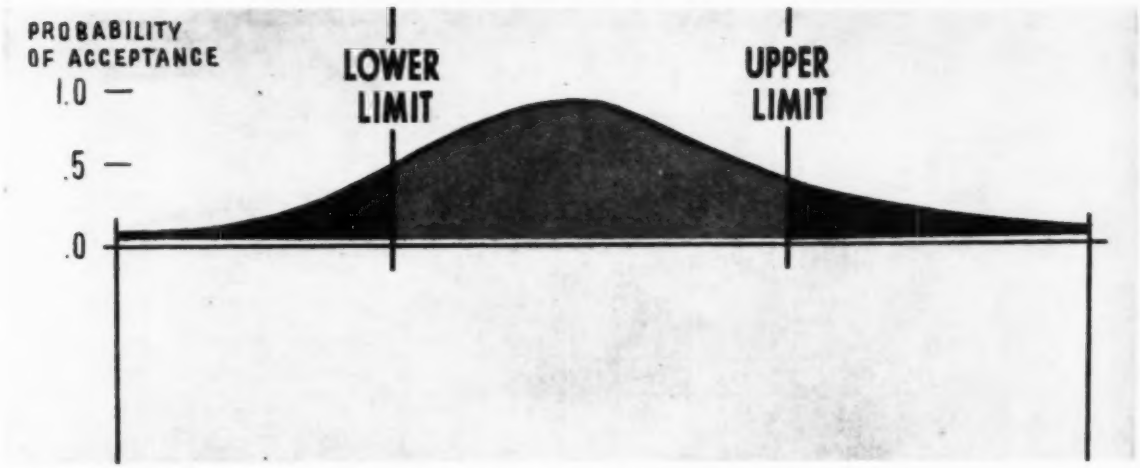
Next we ask the first operator to remeasure each of the ten parts, without showing him his initial measured values. Preferably, he should remeasure the parts in a different sequence. We record these readings in column 2 under his name. The same procedure is followed for Operators B and C.

60 Readings

We have now recorded the first and second readings of each of the 10 parts by each operator—a total of 60 readings with one gage on the 10 parts.

Our next step is to take the arithmetical difference between the two readings of each operator and to enter this difference in column 3 as the R_A, R_B, and R_C differences. You will note that we do not place any significance on which reading is larger than the other. In other words, figures in column 3 for each operator have no sign; all values are considered plus.

Now we total the differences in column 3 for each operator, and divide by 10 to get the average difference. These values of $\overline{R}_A$, $\overline{R}_B$, and $\overline{R}_C$ are entered in the small block at the left side of the form. When we



With poor repeatability . . . accepted parts may be far outside blueprint tolerances and some good parts may be measured as outside the tolerance limits

total these average differences and average them, we get an $\overline{R}$ average (in the example) of 0.00016 in.

Our next step is to check these values for statistical consistency. On the form, just to the right of the $\overline{R}$ average of 0.00016 in., we find the formula, $\overline{R} \times 3.268 =$ limit of individual R's. If we substitute 0.00016 in. in this formula, we find that the limit of the individual $\overline{R}$'s is 0.00052 in. Note that this calculation can be made on the scale directly below. If we set 0.00016 on the $\overline{R}_i$ scale and read on the scale marked UCL_R we will see 0.00052 opposite.

Off-Beat Values

We next scan columns 3, 6 and 9 to see if any individual values of R exceed the 0.00052-in. limit. Three such numbers are found and circled. Thus, on three occasions there were disagreements, larger than would be expected on a chance basis, between an individual operator's measurement of the same part with the same gage. Something was wrong with one of the two readings on these parts.

In line 1, column 9, if we compare Berry's two readings with the other operators' readings, we become suspicious of the –.0015 value. In column 3, line 6, the –.0007 value would be questioned. In colum 3, line 10, the –.0006 value would be questioned. If practical, the operators should repeat these measurements and determine what caused the discrepancy. Sometimes you will find that it is simply a case of an operator misreading the gage.

If it is impractical to replace these readings with new measured values, discard them. The average range should be recalculated, leaving these numbers out of the total and compensating for the difference in number in the average. In this particular illustration a recalculation would give us R of 0.000097 in. (see complete form). With this figure in the formula below the scale ($\overline{R}$ recalculated times $4.564 = 99\%$ repeatability total spread) we get 0.00044 in. repeatability. This calculation can be made with the matched scales directly above this formula marked $\overline{R}_c$ and RTS. Going to the 0.000097 in. on the $\overline{R}_c$ scale, we would read 0.00044 in. on the RTS scale.

Having determined the 99% repeatability total spread in terms of dimensions, we now relate the repeatability figure to the drawing tolerance spread. The formula directly below the repeatability formula shows that repeatability times 100 divided by drawing tolerance spread equals per cent repeatability. In this case, with a drawing tolerance spread of 0.0058 in. and a repeatability of 0.00044 in., the repeatability is 7.6%.

Nomogram Helps

This calculation can be made with a nomogram, which consists of one pair of scales across the bottom of the form, one pair of scales just below the middle of the form and a single scale labeled "per cent' across the right hand border. First mark the drawing tolerance spread on the lower scale (labeled "drawing tolerance spread") and the repeatability on the scale marked "repeatability" (just below the middle of the form), taking care to use the scale marking on the same side of the centerline for both plots. The per cent repeatability will then be calculated by joining these two points with a straight line, continuing this line and reading the intersection point on the "per cent" scale (across the right hand border). In this case the line intersects this scale at 7.6%.

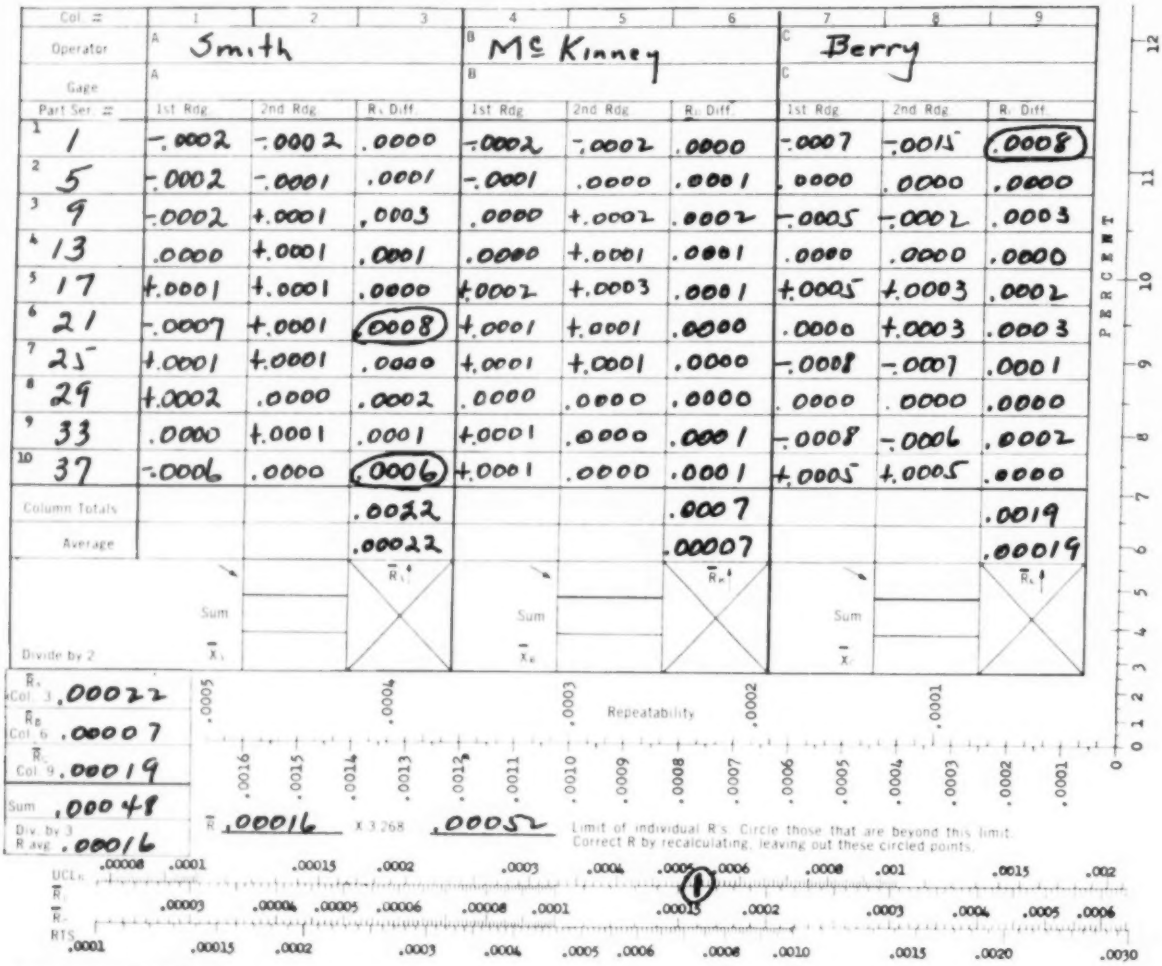
Operator Bias

Although repeatability was our principal concern, we can also compare operator bias with the same data. There were three different operators measuring the same parts with the same gage. Therefore, it is possible for us to estimate the average disagreement among the three operators, and to discover whether the gage is sensitive to handling by particular operators. In other words, this system will measure the potential problems with the gage due to operator bias, such as manner of insertion, manner of reading, and parallax.

If the values that we questioned in the data have been replaced by new readings, columns 1, 2, 4, 5, 7 and 8 should now be totaled. If the values were discarded in calculating a new $\overline{R}$, then we must either replace the suspect data with the oher value in the matching column for this operator (in order that our averages be balanced), or we must discount all readings by all operators for this piece before they are totaled.

After totaling these columns, we next figure the column averages. Adding the averages of column 1 and

Let's take the guesswork out of inspection . . .



Col. =	1	2	3	4	5	6	7	8	9
Operator	A Smith			B Mc Kinney			C Berry		
Gage	A			B			C		
Part Ser. =	1st Rdg.	2nd Rdg.	R$_A$ Diff.	1st Rdg.	2nd Rdg.	R$_B$ Diff.	1st Rdg.	2nd Rdg.	R$_C$ Diff.
1	1	-.0002	-.0002	.0000	-.0002	-.0002	.0000	-.0007	-.0015	.0008
2	5	-.0002	-.0001	.0001	-.0001	.0000	.0001	.0000	.0000	.0000
3	9	-.0002	+.0001	.0003	.0000	+.0002	.0002	-.0005	-.0002	.0003
4	13	.0000	+.0001	.0001	.0000	+.0001	.0001	.0000	.0000	.0000
5	17	+.0001	+.0001	.0000	+.0002	+.0003	.0001	+.0005	+.0003	.0002
6	21	-.0007	+.0001	.0008	+.0001	+.0001	.0000	.0000	+.0003	.0003
7	25	+.0001	+.0001	.0000	+.0001	+.0001	.0000	-.0008	-.0007	.0001
8	29	+.0002	.0000	.0002	.0000	.0000	.0000	.0000	.0000	.0000
9	33	.0000	+.0001	.0001	+.0001	.0000	.0001	-.0008	-.0006	.0002
10	37	-.0006	.0000	.0006	+.0001	.0000	.0001	+.0005	+.0005	.0000
Column Totals				.0022			.0007			.0019
Average				.00022			.00007			.00019
			$\bar{R}_A$			$\bar{R}_B$			$\bar{R}_C$
Sum					Sum			Sum	
Divide by 2			$\bar{X}_A$			$\bar{X}_B$			$\bar{X}_C$

$\bar{R}_A$ Col. 3 .00022
$\bar{R}_B$ Col. 6 .00007
$\bar{R}_C$ Col. 9 .00019
Sum .00048
Div. by 3 $\bar{R}$ Avg. .00016

$\bar{R}$ .00016 x 3.268 .00052

Limit of individual R's. Circle those that are beyond this limit. Correct R by recalculating, leaving out these circled points.

Repeatability

PERCENT

UCL$_R$ .00052
$\bar{R}_A$
$\bar{R}_B$
$\bar{R}_C$
RTS

Gage repeatability test . . . This partial section of the form is used to record two readings by three operators on each of ten parts. $\bar{R}$ average = 0.00016 in. is the first estimate of the average difference of sample sizes.

The limit for any reading of $\bar{R}$ is found by multiplying by 3.268. Thus the limit = 0.00016 x 3.268 = 0.00052. Three circled readings are outside this limit and should be investigated

2 together, and dividing by two gives us an $\bar{X}_A$ as the grand average of all Operator A's readings on these parts. These can be compared with the grand average of columns 4 and 5 (summed and averaged to give us $\bar{X}_B$). Likewise columns 7 and 8 can be averaged to give us $\bar{X}_C$. Under ideal conditions these three measurements would be identical. But under practical operating conditions they won't be the same. We should therefore determine if the disagreement is large enough to make the gage unsuitable.

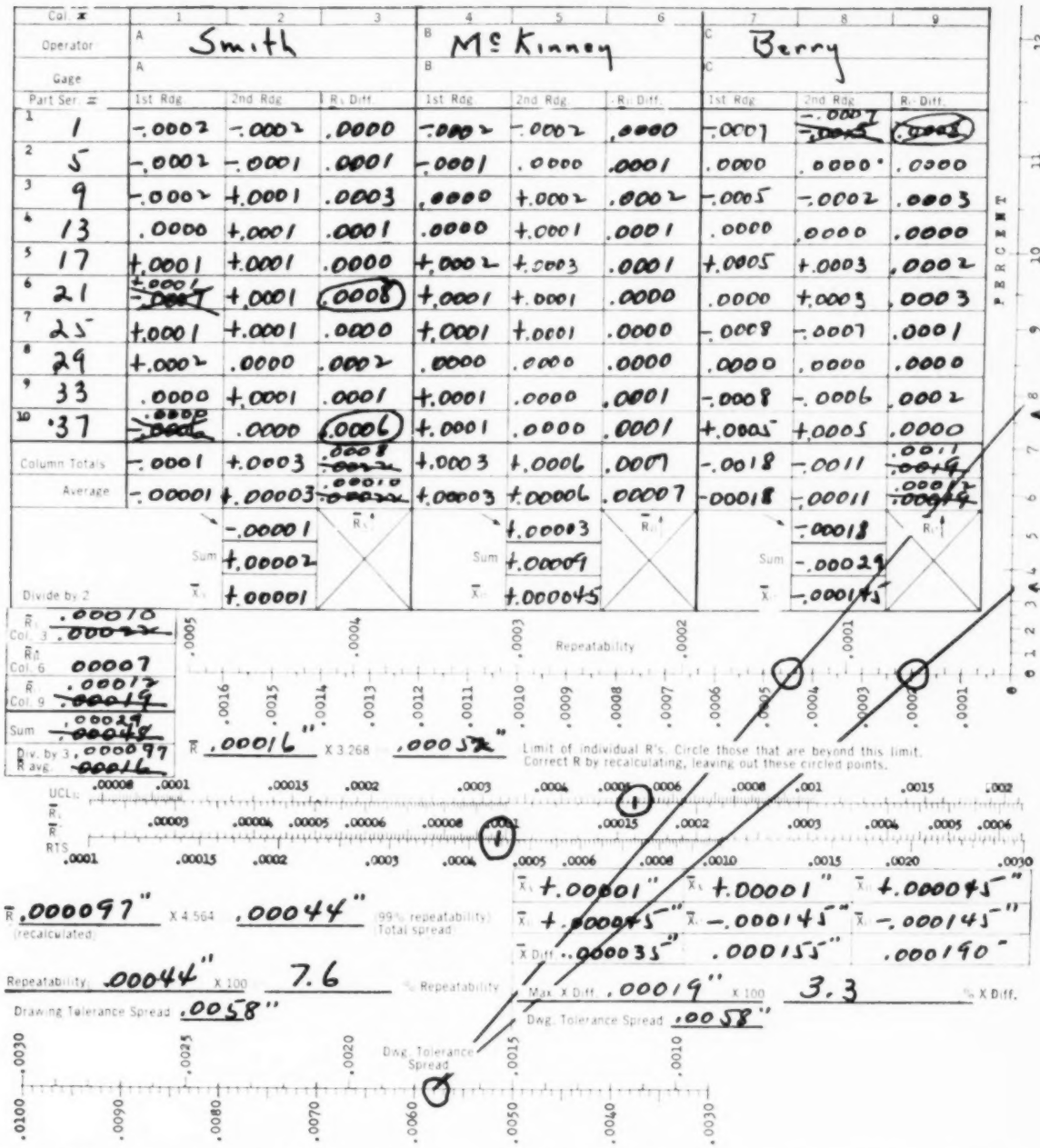
Maximum Differences

On the lower right-hand side of the form there are places to enter $\bar{X}_A$, $\bar{X}_B$, $\bar{X}_C$ in all combinations so that the maximum difference, in this case 0.00019 in., can be discerned. If we relate this maximum difference as a per cent of the specification by multiplying by 100 and dividing by 0.0058 in. the difference is 3.3%. This calculation also can be made by using the nomogram.

Compares Gages

The form is suitable for comparing two gages for calibration or gage bias. Again, measure ten different parts two times on each gage. In this case the same operator would make all measurements. This procedure gives 20 readings by the operator on each gage. Before comparing the averages of these 20 readings for the average bias, we should again make the repeatability calculation and determine if the repeatability of the gages when averaged together meets the 10% of specification tolerance spread required. If this condition is met, we would then total columns 1 and 2, 4 and 5, average them and compare for difference in the same manner that we did for operator bias. This test compares the average difference that results when one operator measures the same parts with two different gages. The limit that we are working to in this comparison is that the average difference shall be no more than 4% of the specification tolerance spread.

Note that we make sure that the repeatability of the gage is within limits prior to making the gage comparison calculation. If the repeatability is poor, it is possible that the



Recalculation of gage repeatability . . . After discarding suspected readings related to the circled figures, average ranges are recalculated for each operator, then R_c is found. R_c is 0.000097, and repeatability total spread, RTS, is equal to 0.000097 x 4.564 = 0.00044 for 99% repeatability. Actually the repeatability equals 0.00044 x 100, divided by drawing tolerance spread of 0.0058, or 7.6%. Thus, gage repeatability is within the required 10% of the tolerance spread

gages will fail the calibration bias requirement. It is better to correct repeatability before attempting to adjust calibration.

Readings for either of these calculations should be estimated to about one-fifth of the calibration marks on the measureing equipment. Rounding off the readings reduces the precision of measurement. In the case of repeatability measurements, rounding off may well mask the real repeatability value.

Excessive Zero Values

The clue to the rounding-off effect is often found when the range values of the R_4 difference include a large number that are zero. In other words, we obtained complete agreement for particular parts in columns 1 and 2, columns 3 and 4, and columns 5 and 7. There will be chance cases in which we do get agreement between the two readings taken by the same operator on the same part; however, the number of such occur-

rences has a practical limit. In this case we should accept a total of seven zero ranges out of the 30 range values as attributable to chance. If eight or more zeros are present, readout is probably not adequate or the readings are not being taken properly. We should, therefore, take a careful look at the gage and the operator's measurement and readout technique. Otherwise, it is likely that the test will not correctly evaluate the true repeatability of the measurement device.

The usual reason for the occurrence of eight or more zeros is that either the gage is not calibrated to a sufficient number of places or the operator is rounding off the measurement. In the first case, the gage will probably not be suitable for the measurement, and in the second case, the repeatability estimate will be inaccurate. In our worked-out example, we have eleven zeros. Here the operators should have been estimating between the major divisions and reading out one more decimal place.

"Decision" Limits

Another important part of the proper interpretation of blueprint tolerance limits is that of determining "decision" limits, the point at which the inspector stops accepting and starts rejecting. Much has been written and said on the proper means of interpreting tolerance limits, rounding off, and how to round off. The important thing in establishing decision limits is for Engineering, Manufacturing and Inspection to agree on the determination method. If the engineer feels and thinks that one thing should be done and the inspector another, the blueprint is voided. We must recognize that the border line between an acceptable reading and a rejectable reading is extremely small. We must at some time make a decision and this decision line must be well established and consistently followed.

Administratively, it is easier to use the blueprint tolerance value as the acceptance limit. Any value greater than this would be rejected. This is administratively simple in that it requires no calculations, no rounding off, no interpretation of the meaning with different tolerance ranges. At our Evendale, Ohio shop, this is the procedure that we use.

A problem bound to come up, and requiring understanding, is the case of borderline rejections. In many shops the inspector may accept borderline rejections knowingly in order to avoid an argument when someone else measures the part and finds that it is just inside the specification limit. Because of the repeatability problem, we must recognize that there will be cases of disagreement in which one measurement says the part is acceptable, and another measurement says reject it. We must, of course, know what we should do to settle the argument.

When two measurements on the same part disagree on acceptability or rejectability, we believe that the decision should be based on the average of the two readings, rather than accepting either reading. This is a rational decision, because the average of two measurements normally will be closer to the true value than an individual reading. We reject the concept of throwing away either the rejection or the acceptance reading based on the disagreement alone. However, if we take sufficient data to show that a reading is beyond the chance limits of variability, as established by several readings, we would then throw this reading out of our data and make the decision based on the average of the remaining values.

We feel it unwise, however, to go into a statistical examination of each borderline case. The inspector should make the decision and call parts as he sees them. Only in borderline decisions on important parts, where the rejection creates a serious problem in production, would we consider making a statistical study or doing further testing to try to save and accept the borderline case. In some plants routines are established, such as a Materials Review Board, for accepting usable out-of-print dimensions. They relieve the inspector of the pressure to accept an out-of-print part in order to satisfy production needs.

Better Gage Designs

While the testing of repeatability and bias of gages seems to be an expensive and time-consuming chore, there are benefits to be derived from it. One of the important gains is the improvement that we encourage in gage designs. To meet requirements, our vendors find it necessary to make better designs, more carefully thought out and with better readout equipment. This tends to force improvement in gage design to match the trend to tighter tolerances.

Improved performance of the end product can result from our ability to hold tighter tolerances. However, we must recognize that simply putting a tight tolerance on the print does not in itself assure that the parts will meet these tolerances. We must have manufacturing equipment capable of manufacturing the part to the tight tolerances, and we must also have measuring equipment with suitable accuracy and precision to measure the parts correctly.

A real gain which can be obtained from enforcing the repeatability and bias test limits is reduction of the number of disagreements that result from the variation from one gage or one measurement to another. In vendor-vendee relations, disagreements over measurements can be very costly in terms of delay and expense. On the other hand, by suitably testing and correlating the two sets of gages so that the vendor and the vendee use measurement equipment which closely agrees, we forestall expensive and time-consuming controversies resulting from disagreements over particular parts. If the vendor is familiar with the results of such testing, he can further protect himself by assuring that his own inspection and manufacturing people weed out the borderline cases prior to shipment. This will improve his quality record with his customer.

Obviously, within a plant the same kind of disagreement is possible between the machinist and the inspector. Again, we need precision tools calibrated to the same standards and in close agreement with each other. In this way we can reduce the amount of measurement controversy.

Reduces Controversy

If manufacturing supervisors understand measurement variability, they can reduce and perhaps eliminate controversy. This can be done by holding process limits a little tighter than the specification limits so that inspection is not confronted with borderline cases.

One of the more important gains realized from suitable repeatability and bias testing of gaging is that it adds real meaning to inspection data. From an engineering point of view the estimate of part size made by inspection is not complete unless we have a good idea of the amount of uncertainty associated with determination of the measured value. Certainly from the point of view of calculating the possible effect on performance of the end product, the uncertainty of the measurement is extremely important. It should be removed if possible.

THREE-STEP FORMULA SHOWS . . .

How to CORRECT your employees

By H E Carroll

Employee criticism is a necessary part of successful shop management. Regardless of how effective a worker is on the job, there are times when you have to make some suggestions for improvement—to correct his errors or to encourage better performance.

Shop management will agree with the need for correcting employees. But they also know that there is always the danger that the criticism will boomerang. The corrected employee may not take your criticism in the helpful way you intend it, and more serious employee-relations problems may develop.

It is never a pleasant task to criticize an employee. Withheld too long, criticism can become an ulcer-producing problem. At the breaking point, the employee is criticized to relieve the tension, and the results can be disastrous.

Here's an easy, effective formula to follow for correcting your workers. This plan points out the error to the employee and makes a suggestion for improvement. More importantly, it enables you to retain the good will and cooperation of the employee being corrected. The formula can be reduced to three steps:

- **Compliment**
- **Correct**
- **Encourage**

As you can see, this formula sandwiches the criticism between two happy thoughts—a compliment and a word of encouragement. If you follow it, you'll have time to get into a friendly frame of mind rather than fly off the handle with quick words of criticism.

Step One: Compliment

A basic rule of the formula is to think of something good the employee is doing or has done in the past. It may take a few moments to think of this part of the formula, but this time helps take the edge off your anger.

You will find that your compliments are most effective if they are based on something unrelated to the criticism. For instance, if you plan to give a corrective suggestion on safety, you will find that a compliment on something else, such as his cooperative attitude, will be better than a statement on his safety record.

One suggestion: Don't be too brief in your compliment. If you do, it may sound more like flattery than compliment. For instance, don't say "Jim, you have a cooperative attitude, but. . . ." This brief compliment doesn't have time to sink in and soften the blow of the criticism that is to follow.

You can add substance to your initial compliment in the formula for criticism by citing a specific example. It makes your compliment more believable.

Step Two: Correct

Many supervisors have found that criticism is accepted better by a worker when it is offered as a suggestion—not a command. For instance, you might preface your correction with something like this: "May I offer a suggestion?"

Another helpful idea is to point out a benefit—something the employee will gain by following your suggestion. For example, you might stress that the correct way is easier, faster, and safer. Any benefit that the employee can readily understand can be used in this part of the corrective formula.

Thus, you might say here: "May I offer a suggestion? I think you will find it a lot easier and far less dangerous. Here, let me show you."

Now you show the employee the correct way to perform the task. You will want to do this slowly. Don't show too much skill yourself or the employee may feel it is too complicated, and the suggestion will be lost.

As you perform the operation you will want to stress the main point. For example, if safety is to be stressed you want to be sure that your performance is handled safely. If speed is to be stressed, you eliminate all lost motions in your instructions.

Finally, you nail down the correction. It's a good idea to have the employee repeat your performance in the approved way. You check to make certain it is done correctly. If your suggestion is verbal, you ask a positive question that gets agreement: "Don't you agree this way is easier?"

Step Three: Encourage

You can take some of the sting out of your criticism by ending with a word of encouragement. The employee is not left with the feeling that he is inadequate. He develops confidence that he can do better in the future.

A good technique is to compliment the worker on something from the past. You might say, "I know you can do this faster. You've been one of the top men in the department, and I'll bet you'll be leading again."

Another technique you may find helpful in this part of the formula is to repeat the benefits. After you have shown the faster, safer, and better way to perform the task, you may want to mention again what the employee will gain.

Shop management at all levels will find that this formula accomplishes the task—corrects the employee—and at the same time retains the cooperative spirit among employees that is so important for profitable operation of the business.

Ring gage for a Hydrocone crusher was made by laminating glass cloth with sand-filled epoxy. Mold on the table was built with glass cloth and epoxy resin. One plastic can be cast against another to duplicate dimensions if a parting agent is applied

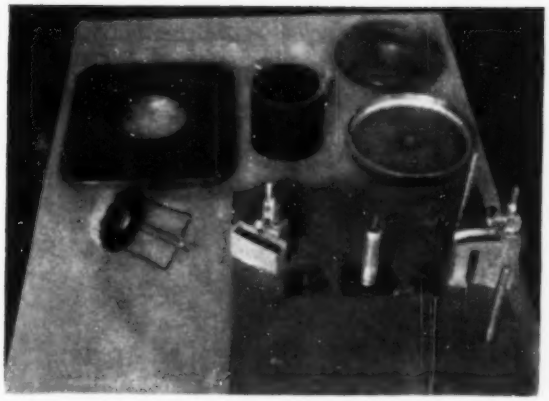
These plastic tools saved money

By J Bruce Ferguson, project superintendent, foundries & pattern shop, Allis-Chalmers Mfg Co, Milwaukee

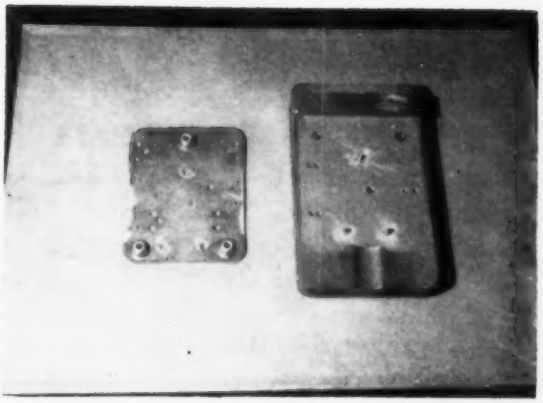
Spotwelding fixture made of fiberglass tubing is for switchgear assembly. Plastic holds dimensions well and is stable over long periods

Cast and laminated epoxy tools make four kinds of savings for Allis-Chalmers: tooling time, fabricating cost, weight, and repair effort. Tools made of filled epoxy resins are mechanically and chemically stable, and they are easy to handle. They can't be applied in all cases, but where they fit they do an outstanding job.

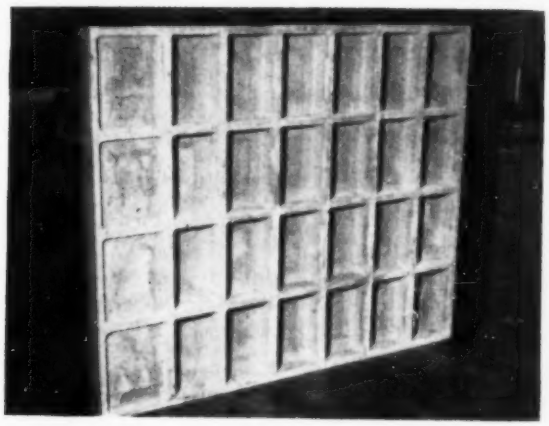
One good application is for drill jigs, where a sample part can be laid out, drilled, and inspected for accuracy. This part becomes the model for tool fabrication. Steel pins are inserted in the drilled holes, then hardened drill bushings (knurled on the OD) are slipped on over the pins. A parting agent is applied to the part, then epoxy resin is cast within a frame around the bushings. After cure, the plastic casting becomes the top leaf of a



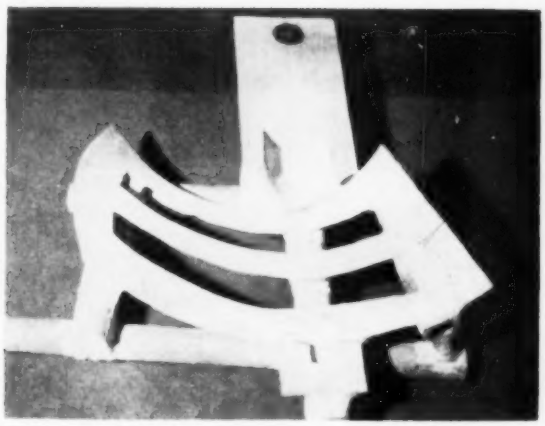
Arc-welding fixture positions parts for a rectifier tank. Plastic base and supports for metal clamps were built from parts drawings



Open drilling fixture was built by casting to prototype baseplate (left)



Checking fixture for turbine-blade layout is 50 x 60 in. with 1-in. ribs and 1-in.-thick base. Weight is 328 lb



Inspection fixture can check contours on impeller vanes and may also be used for part layout before machining

drill fixture for the production part.

For larger parts that require close tolerances on hole locations, plastic tubing is laminated over the work, and areas over hole locations are cast with machinable resin. After cure, the plastic is jig-bored at hole locations about 0.002 in. over drill-bushing size, and the bushings are pressed into place, held by an epoxy bonding resin. If hot chips on the plastic areas next to the bushing become a problem, a high-temperature casting resin is applied, or a heat-resistant ceramic layer about 0.125 in. thick is coated over the bushing. Tool accuracy with either casting or laminating is good to ± 0.001 in.

Fixtures for spotwelding are built up from plastic tubing, with metal-faced locating plates and clamping points. And fixtures for consumable-electrode arc welding have been built, using metal plates for ground return. Heat problems are solved with ceramic inserts; metal beads do not adhere to the plastic, so fixture cleaning is eliminated. Plastic fixtures draw away much less heat from the welding operations, so welding is more efficient.

Inspection gages can also be made by casting against machined-and-certified prototype or sample parts. Epoxy expands at almost the same rate as steel when heated if it is reinforced with fiberglass and laminated, so inspection fixtures are made this way . . . not cast. When multiple gages are required, they can be duplicated easily.

Milling fixtures can be built, too, if they are adequately reinforced with plastic tubing or normalized weldments. The most critical feature is clamping; forces and pressures must be carefully engineered so the plastic structure will not distort.

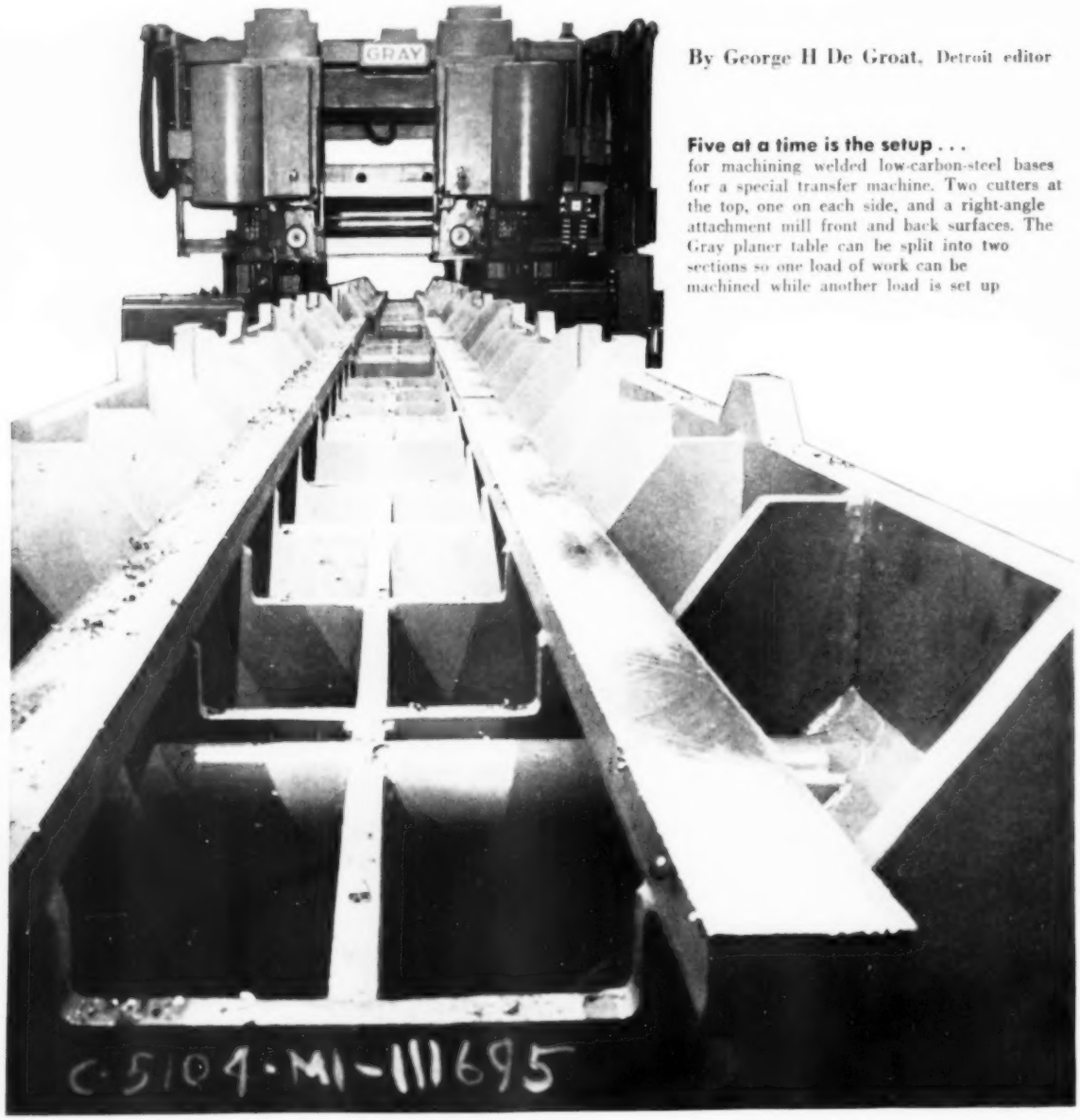
Plastic dies in which electrical elements can be encapsulated are practical. These must withstand temperatures of 250-300 F for periods up to 12 hr. The dies can be cast from a wood model of the end product, or for large quantities, can be made from plastic duplicates, which withstand wear better.

Plastic tooling is subject to stress problems if forces are unbalanced, and to heat warp if large metal reinforcements are included. Temperatures over 175 F indicate special epoxy formulations. But careful planning can result in highly efficient, light, and inexpensive tools.

MODERNIZATION and BUILDING-BLOCK design...

. . . cut costs on special machines. Here's how one machine-tool builder eliminates "tailor-made," individually designed components, and avoids the expensive manufacturing setups they require. The trick is in standardized components —designed to suit new plant equipment.

By George H De Groat, Detroit editor



Five at a time is the setup . . . for machining welded low-carbon-steel bases for a special transfer machine. Two cutters at the top, one on each side, and a right-angle attachment mill front and back surfaces. The Gray planer table can be split into two sections so one load of work can be machined while another load is set up

Cutting manufacturing costs when every job in the shop is "special" presents a big problem to any machine-tool builder. But Buhr Machine Tool Co, Ann Arbor, Mich, has met this demand with two important steps. One is building-block design, in which various components and subassemblies of special machines are identical. Thus jigs, fixtures, and mass-production techniques can be applied to build these machine components in production lots. The second step is the addition of modernized production equipment to their production facilities.

In addition to manufacturing advantages, the building-block principle eliminates some of the problems of completely original design normally encountered with special machines. Greater emphasis and a maximum effort can be applied to designing individual components. Problems of one design stage are effectively separated from—and do not adversely influence — solutions to other design stages.

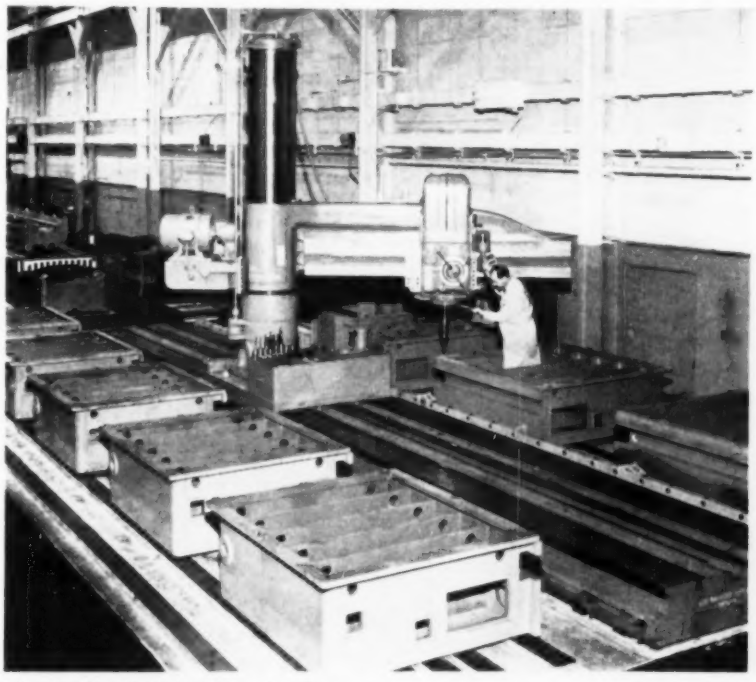
The tie-in between machine design and manufacturing facilities permits machine designers at Buhr to be unusually conscious of production methods. Machine designs are always developed with the limitations of production equipment in mind. For example, when a planer was the biggest machine in the shop, designs provided for as many straight-through cuts as possible. The designs were good, but material costs were high. Now, with a large new Gray planer-miller, cuts can be made between ribs and right up to the wall of a large part. Result is lowered material costs and reduced manufacturing time. The new planer-miller has four milling heads and a table length of 50 ft, made up of two 25-foot duplex tables.

Automatic positioning is applied to the table and heads. Workpieces up to 78 in. by 66 in. by 50 ft. long can be accommodated. In a typical setup, five standardized machine bases, each about five feet long, are loaded on one duplex table while rough machining operations are performed on the other. In this way, machine downtime for reloading is nearly eliminated. All clamps are released and then re-applied between cuts to prevent building up stresses.

For speed and accuracy, the machine is also used occasionally for precision drilling and boring. Partial jig strips can be located on bored machine bases.

New roll-over jigs with drill bushings to suit a particular pattern

An order for 42 machine fixtures . . .
is processed in this Giddings & Lewis planer 16 at a time. Operations are performed in three setups: rough machine top surfaces, rough and finish the bottoms, and finish the tops. Two cutters take different kinds of cuts simultaneously

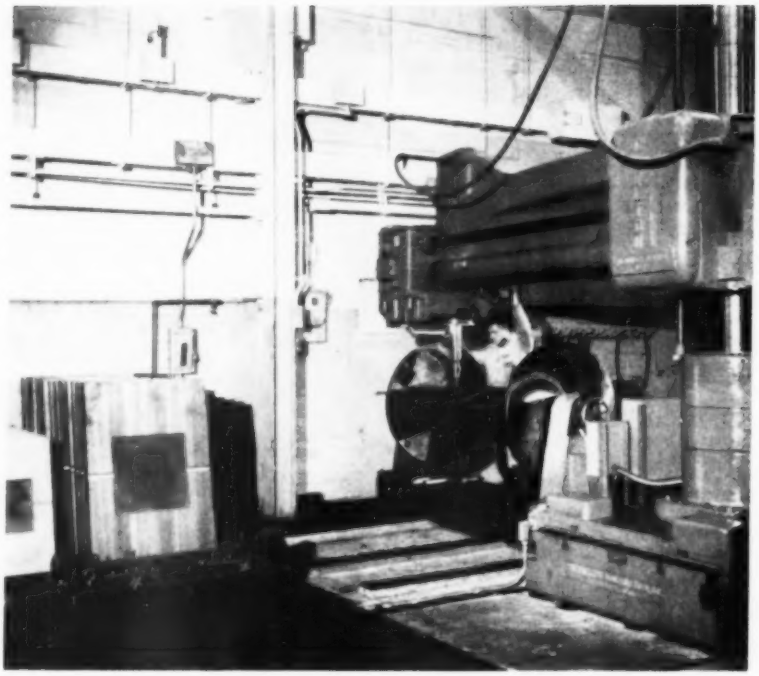


Identical building-block wing bases . . .
are drilled at this Carlton radial with hole-pattern jigs that eliminate time-consuming layout. Parts are set up on one side of the machine while drilling is done on the other. Rails in the floor support the work and are part of a structural steel network embedded in concrete for this purpose

eliminate layout work. These jigs permit drilling the platens from the top, bottom, and either side with just one layout. A supply of platens of one size is drilled this way, then the jig is replaced so a supply of a different size can be drilled. Lot sizes are larger than was previously possible and setup time per piece is zero.

Buhr's investment in modernized plant equipment amounts to almost a million dollars. The increased productive capacity, and the savings that more economical processing will bring, are expected to permit an early return of this investment. Although directly related, the advantages of building-block design cannot be computed in terms of dollars-and-cents savings, but it is apparent that this principle will also contribute greatly to a short writeoff period.

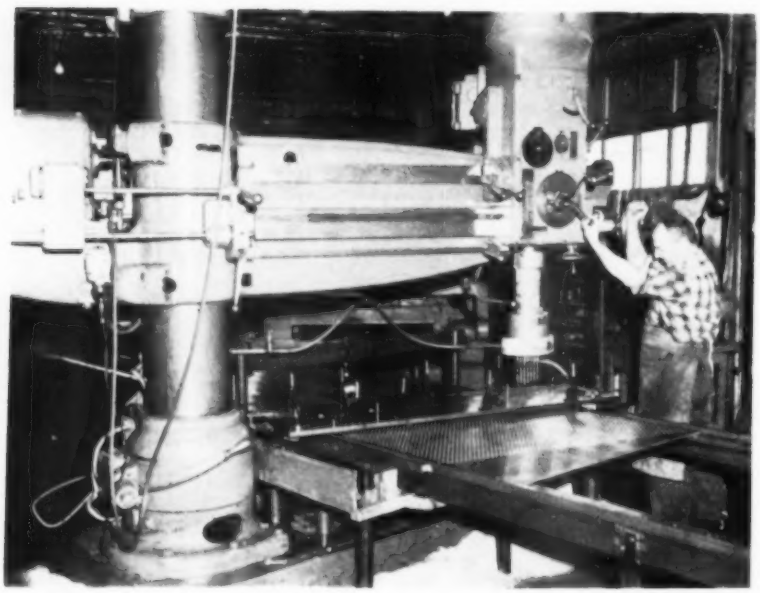
Longer machine life results from building-block design because standardized components can be rearranged, removed, or added as necessary. For radical changes, a special machine can be disassembled or broken down into its standard components and reassembled into a new design. Changing over a machine to produce a different part is a matter of changing fixtures and multiple-spindle heads.



Standardized platens . . . for vertical or horizontal feed units in transfer machines are made in various sizes (left). Radial drill and rollover jigs are easy to operate; all holes of a single size are drilled before replacing the drill and proceeding with the next size required, for which another platen can be installed

Small shop drills 10,000-hole plates

By A F Bartsch, president, Bartsch Tool Corp, Chicago, Ill



Drill plate and 6-ft arm . . . are locked at 16°5′ 46″ angle with the base and frame. Outer end of arm is secured to the floor to prevent arm from lifting. Spindle drive is regeared to provide 0.002-ipr feed

As a small-shop operator with a standard radial drillpress as your best and largest drilling machine, would you take on the job of drilling precisely sized and spaced holes in large plates? The answer in most cases would undoubtedly be no, especially if the job called for thousands of holes.

This obstacle did not discourage the Bartsch Tool Corp of Chicago, who approached the problem with an ingenious work-handling setup. The plates which had to be drilled were 10 ft long, in widths of 48 and 54 in.

To attain the required accuracy, a

drill jig and support frame were constructed and fitted to the base of a 6-ft American radial drillpress. The jig and center section of the frame is supported by eight 12-in.-long legs fastened to the drillpress base. A $1\frac{1}{8}$-in.-thick HRS plate, 3 ft x 6 ft, serves as base for the jig and carries pads at both ends to support the drill plate. The drill plate contains three rows of hardened drill bushings, spaced triangularly so all adjacent holes are 0.816-in. apart. The two outer rows have 75 bushings each, and the center row 74. A fourth row of 4 bushings is used with indexing pins to locate the work from the previously drilled row of holes.

Lengthwise adjustment, to coordinate one set of holes with the next, is provided for in a precision-ground slot at each end of the jig plate. These slots work on dowels inserted in the pads on which the jig plate rests.

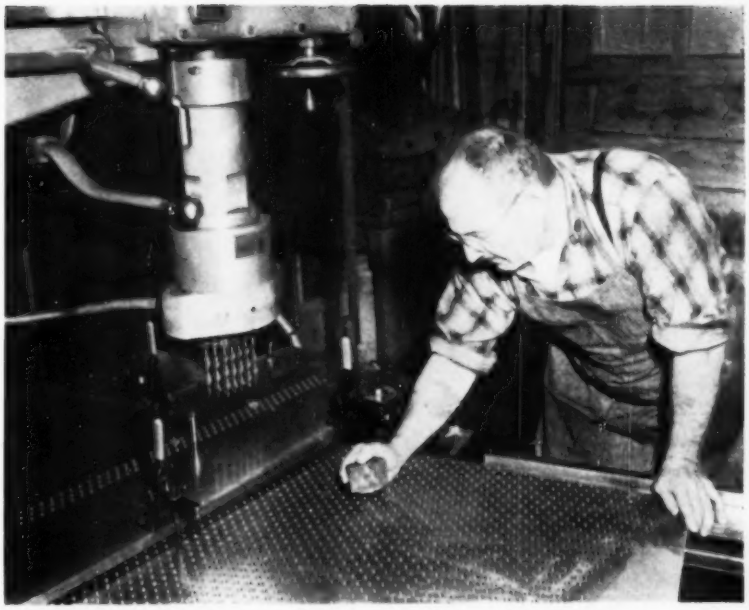
The extending ends of the 27-ft-long frame were leveled with the aid of a surveyor's transit to insure perpendicular location of the work with relation to the drills. An adjustable outer rail with screw-adjustable gibs for aligning the workpieces with the stationary inner rail, makes it possible to accept both plate widths.

Though the plates are surface ground for flatness, toggle clamps hold them in contact with the lower jig plate during drilling. These clamps are spaced along both sides of the upper jig plate, and a 3-in.-dia. by 3-in.-long roller, mounted on a crossbeam, prevents the workpiece from lifting when the clamps are released.

For multiple drilling, a special 17-spindle Zagar drill head is affixed to the drillpress quill. In this setup, 15 spindles are employed in three rows of 5 drills each. Subland, or two-diameter, drills are used to reduce drilling pressure. The minor-diameter sections ($\frac{1}{4}$-in. dia and $\frac{1}{2}$ in. long) are designed to pass through the 13/32-in. plate thickness before the 0.406-in. major-diameter lips start to cut. Clearance holes in the jig base permit chips to escape.

A wax-type cutting fluid, consisting of Johnson 250-J-Cool mixed with water in a 1:30 ratio, is pumped through the drill head to keep it cool. The flow then continues to the drills through a copper-tube manifold with outlets formed by milling 1/16-in. wide gashes at intervals across the $\frac{1}{4}$-in. dia tube.

The plates were drilled under a subcontract for Chicago Bridge and Iron Co to be used by the Convair Div of General Dynamics Corp in construction of a high-speed wind tunnel. Material for the screens thus produced was stainless steel, and the hole tolerance was 0.405-0.407 in. The 48-in. wide plates required approximately 9,120 holes and the 54 in. plates about 10,250. Hole pattern was the same for both sizes.



Three pins of plug gage . . . must fit easily in any three adjacent holes which are centered on apexes of equilateral triangles with 0.815-0.816 in. sides. Toggle clamps hold work tightly against jig base

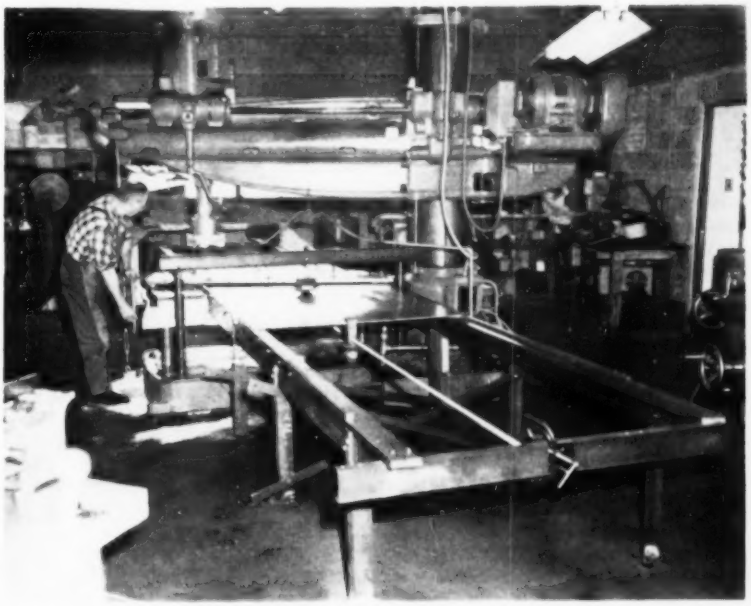


Plate is guided and supported . . . between side rails of floor-mounted frame extending 12 ft on either side of 3-ft jig. Work is moved through jig with handwheel connected through bevel gears with 12-ft leadscrew. Leadscrew nut is clamped to end of plate

Templets directly from drawings . . . is the first step in making turbine buckets or compressor blades. This first of a two-machine team at Solar duplicates airfoil sections drawn in electrically conductive ink. Milling head, guided by a non-contacting electronic tracer system, produces the templet within 0.001 in. of drawing dimensions

Electronic millers speed

By George H DeGroat, associate editor

Two fancy milling machines, purchased recently by Solar Aircraft Co, have drastically reduced the lead time for developing the company's new gas-turbine engines. The machines make compressor blades and turbine buckets for the engines. One unit makes templets directly from engineering drawings; the other produces the parts from the templets.

Development of any new gas-turbine engine requires weeks of calculations, as well as the manufacture of a number of sets of blades and buckets. A series of tests shows whether the parts have to be modified or redesigned. Experiments continue until optimum blade design, for best engine performance, is found. Until now, development time stretched out because the company had no fast, accurate way to make the blades.

By speeding up blade production, the machine combination has shortened testing time considerably. It helped lop almost a year from estimated development time for Saturn, the company's new 1000-hp engine. The combo has also been applied successfully in the development of the new 55-hp turbo-shaft Titan engine, which weighs only 50 lb and will power one-man helicopters and flying platforms ordered by the military.

The two machines not only speed manufacture of prototype and experimental engines, but also simplify production of a standard line of gas-turbine engines in the 50-to-500-hp range. Moreover, they make it easy to make master blades for vendors, as well as cams, punches, and other parts of irregular contour.

The "team" consists of two New England Machine and Tool Co machines, serviced and distributed by Pratt & Whitney Div of Niles-Bement-Pond Co.

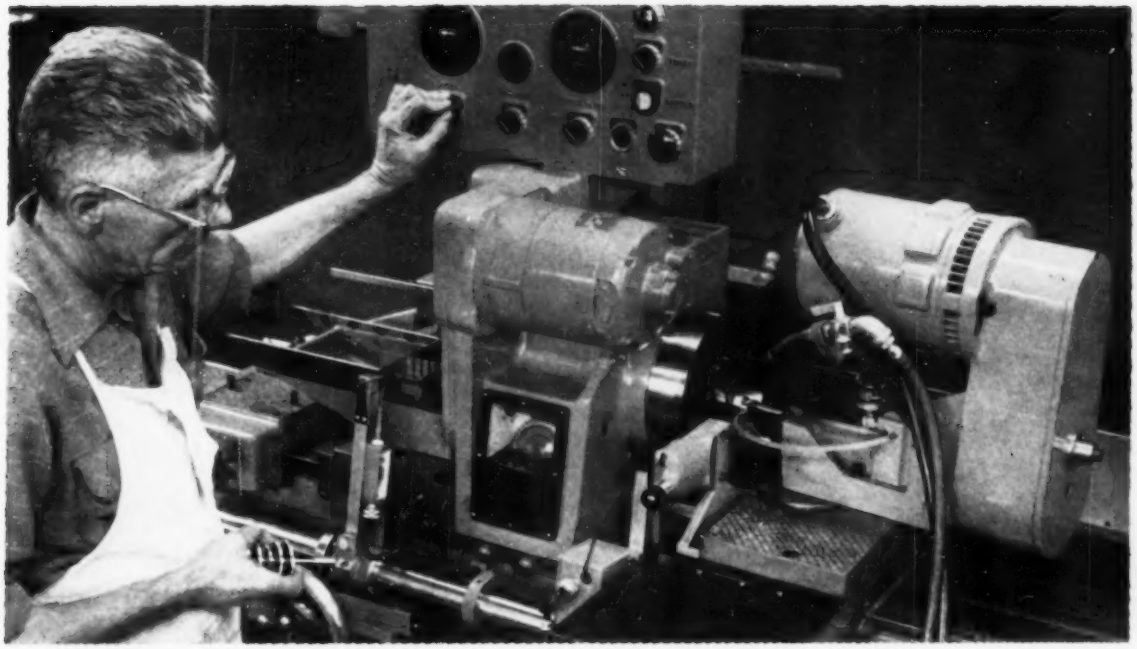
Making the Templets

First member of the team is a templet and cam milling machine controlled by an electronic tracer system. **This machine operates directly from multiple-size drawings, and can produce any external or internal contour that can be generated by the cutter toward and away from the center of a rotating table.** Accurate templets made here are then transferred to the second machine, which makes the actual blades and buckets. For each cross section on airfoil drawings, one templet is made.

First step in making a templet is to prepare—on vellum, ordinary drawing paper, or glass cloth—a sectional drawing of a compressor vane or turbine bucket. The "ink" is a conductive metallic solution, such as silver nitrate. Only one edge of this conductive (and grounded) line has to be drawn accurately, because the tracer is a disk that approaches and follows only one edge—without touching it.

When the tracer is sufficiently close, a spark jumps from it to the grounded line. This spark gap establishes a voltage that can be measured accurately by electronic circuits. And electronic "anticipation" circuits in the system can measure the rate of extremely small changes in the gap.

Output of the control circuit con-



Second machine in the team . . . makes buckets or blades from templets (one for several cross sections of airfoil) stacked on an arbor. Carbide cutter at right mills bar stock continuously, guided by an electronic tracer that accurately blends airfoil form between airfoil section stations by interpolating both shape and twist

airfoil machining

sists of two dc channels that vary inversely in magnitude as the spark gap varies and become equal at a spark length of 0.001 in. These channels determine the amount-of-drive in a pair of oppositely driving magnetic clutches geared through independent trains to the slide.

Two independent systems control the templet-making machine. The first permits the carriage to follow rises and falls of the line drawing during rotation of the drawing table. The second permits the cross slide (carrying the work spindle head) to follow an adjustable ratio bar, mounted on the carriage, that provides duplicated but reduced motion. With a micrometer adjustment, the operator can change the position of the cross slide relative to the ratio bar, adjusting the setup to leave stock for subsequent finishing cuts.

To make the templet, the operator orients the drawing and secures it to the drawing table, then places the templet stock on the machine's worktable. Rotation of the drawing table and worktable is always exactly at the same rate, for both are driven by a variable-speed motor through a common worm-gear drive.

During this rotation, the tracer slide moves toward and away from the center of the drawing table, and the non-contacting tracer disk follows the edge of the silver line on the drawing. Tracer slide motion is transmitted at a reduced scale to the second slide, which carries the work head and spindle and which moves at a 90° angle to the tracer slide. **This precisely determined motion of the second slide controls the milling cutter, which reproduces the contour of the drawing in the templet stock—at a reduced ratio of 10:1 or 20:1.** Size relationship between tracer disk and milling cutter is the same as that between drawing and workpiece.

Making the Blades

Second machine in the combo is an electronic airfoil milling machine that uses the finished templets as patterns for producing blades or buckets from Hastalloy C, stainless steel, or other bar stock. Templets (one for each cross section specified on a vane drawing) are spaced on an arbor and aligned so that all chordal tangents are parallel.

Three primary motions generate the blade shape:

(1) rotation of the workpiece about its axis

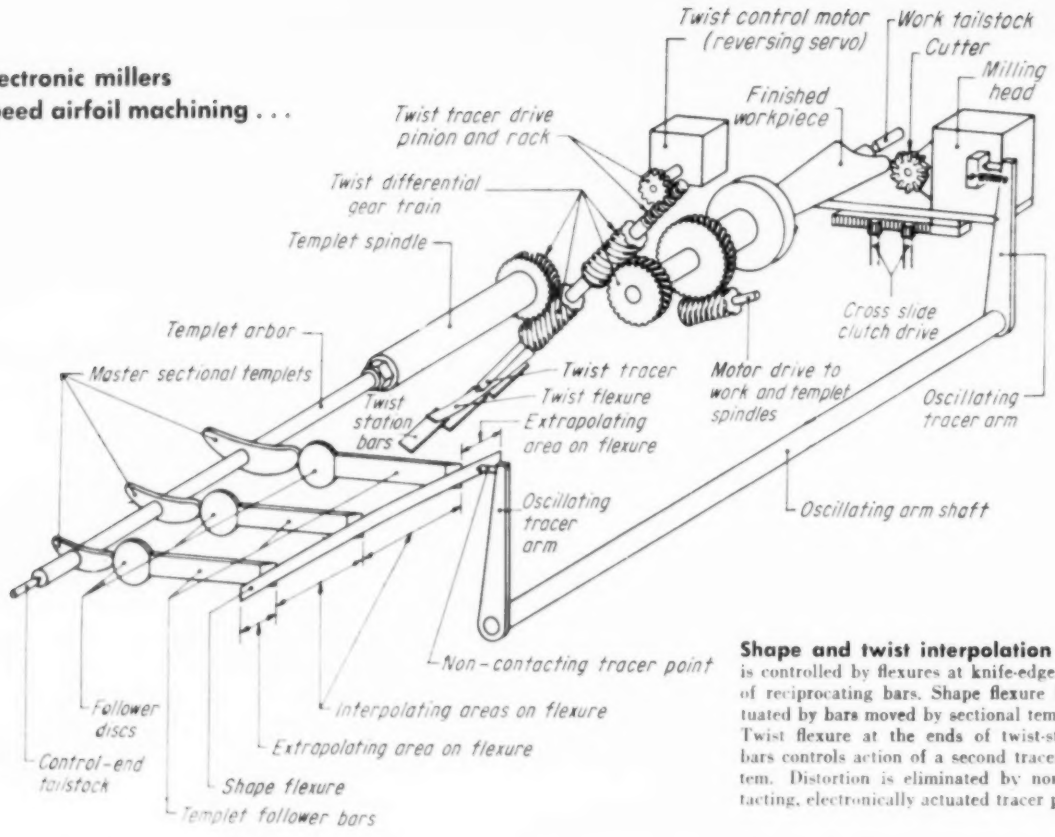
(2) tracer-controlled reciprocation of the milling head toward and away from the work axis

(3) slow, continuous feed of the carriage parallel to the work axis

Ordinarily, airfoil shapes appear on drawings as a series of three, four, five, or more cross sections. The required twist, or helix, of the blade is indicated by drawing the various sections in their proper angular relation to the blade root.

The old way of making masters was to blend, or fair, by hand the areas between the sectional references; here the accuracy of the blend was entirely dependent upon the skill of the patternmaker. Of course, this method required considerable time. **With the new setup, Solar pro-**

Electronic millers speed airfoil machining . . .



Shape and twist interpolation . . . is controlled by flexures at knife-edge ends of reciprocating bars. Shape flexure is actuated by bars moved by sectional templets. Twist flexure at the ends of twist-station bars controls action of a second tracer system. Distortion is eliminated by non-contacting, electronically actuated tracer points

duces uniformly accurate masters, as well as complete sets of blades, within hours instead of weeks.

Shape and Twist

Two separate processes continuously generate a completely faired total surface on a blade during the milling operation. One process interpolates the cross section between templets with a moving member, or "flexure," that acts as if it represents successive fairing elements of an imaginary master blade—one that has the correct cross-sectional contours but lacks twist. The second process introduces the desired twist by a programmed rotation of the guiding templets relative to the work rotation. Both processes work concurrently.

In the **shape interpolating process** (see sketch), each of the rotating templets in the stack drives a sliding bar in the exact motion required to mill the desired shape at the corresponding cross section of the workpiece. All instantaneous positions of the flexure member represent the positions required of the milling cutter at all points between the specified cross sections.

If the flexure member is to correctly represent fair elements joining similar points on all templets, the templets must be aligned with little angular displacement between their respective features of similarity. This creates the need for the second function of the interpolation process: introduction of the desired angular displacement between specified cross sections of the workpiece.

Twist is introduced into the workpiece through a differential gear train that rotates the stack of templets relative to the instantaneous position of the work. The differential is controlled by the second (twist interpolating) system, which consists of a set of bars with magnetized knife edges. Spaced at intervals corresponding to the templets, these bars are mounted on a carriage that moves longitudinally with the cutter-head carriage. The knife edges project from a reference point a distance proportional to the twist required at each cross-sectional station. Flexible feeler stock lying across the knife edges provides a smooth curve representing twist at all positions.

Through the action of a second non-contacting follower, the twist-differential gear train is operated in proportion to the height of the curve as the carriage passes by. As in the first machine, the non-contacting tracer system maintains a given length of spark gap between the flexible member and the tracer to accurately control cutter position.

Duplicating Parts

Small quantities of duplicate shapes, for experimental purposes, can be made in this machine without templets. **The machine can, for example, duplicate a master airfoil shape, copying from a complete airfoil.** Here the control-end carriage is tied to the milling head to move with it over the slow, continuous feed parallel to the work axis. Only one sliding knife-edge templet bar is required on top of the carriage. The spark gap then occurs at the circumference of the follower roll rather than on a flexible member at the knife-edge end of the bar.

This method of direct copying is especially useful for producing small quantities of many different airfoil shapes, or for making master blades that can be used as patterns for production casting. Because the tracer can climb steep angles, both the airfoil and its base can be milled from solid bar stock in one operation.

Bridgeport Ultra Fine Grain Brass Strip Saves Siesta-Ware $2,400 a Year

Colorful Siesta-Ware is designed to create a holiday mood ... and so are the remarkable production savings realized by Benner Glass Company!

Before Benner Glass Company, Jacksonville, Fla., made the happy discovery of Bridgeport Ultra Fine Grain Brass Strip, production of the brass banding on each attractive Siesta-Ware Party Mug, Snack Jar and Tumbler was at the rate of two coils of strip running at 35 lineal fpm through three buffing stages. Today, with Bridgeport UFG Strip, the same machine runs *at the rate of 48 fpm!*

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Don't *you* overlook the sizable savings that can be yours when you switch to Bridgeport Ultra Fine Grain Brass Strip. To get the facts and figures as they apply to your products, call *your* nearby Bridgeport Sales Office... or write direct for a copy of our Ultra Fine Grain Brass Booklet, GRAIN SIZE, THE FOURTH DIMENSION. Dept. 3003.

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Deflection .0013" Per Foot–Parallelism .00025" Per Foot Over 40 Feet in this Giant 4000-Ton Press Produced by DANLY for A. O. Smith Corporation

Side members for truck frames are stamped out in sizes up to 40 feet in length for the heaviest duty trucks in this 4,000-ton Danly press at the Milwaukee Plant of the A. O. Smith Corporation. The press slide comes down once and a heavy-gauge steel "sidebar" is ready for assembly. The press operating rate is 10 strokes per minute.

The bed deflection .0013" per foot—measured and tested by A. O. Smith engineers—required a bed so massive that it had to be made in two halves along the right to left center line, to stay within transportation limits. The halves are tie-rodded and keyed together.

The cushions, placed in the bed opening, are so constructed that they will absorb any extremes of off-center loading.

The bed surface and slide each machined at one setting—checked out flat and parallel within .009" over the 40 ft. length representing a parallelism bed to slide .00025" per foot.

The Danly Microinching Drive will move the slide through an entire cycle at slow speed for die setting and produce an accurate part without stopping the flywheel and deliver full-rated capacity of the press.

The extremes of weight, size and accuracy of welded-steel fabrication and machining represented in this press were achieved by the combination of heavy handling equipment including 100-ton Whiting Cranes and the 7" Giddings & Lewis Horizontal Bars mounted on 100 ft. runways in Danly's new facilities.

The press is now operating. It is reflecting the accuracy of manufacture to its great size by stamping accurate parts in daily production.

This press was designed specifically for, and in cooperation with, A. O. Smith Corporation, pioneers in efficient production and leading supplier to the automotive industry . . . by Danly, the leading supplier of stamping equipment to the automotive industry.

This press typifies Danly's ability to work with you to design, engineer, and produce new presses for new applications to increase capacity, lower stamping costs, lengthen die life, and reduce downtime. Find out how.

WRITE FOR CATALOGS that interest you on:
Danly O. B. I. Presses • Straight Side Presses
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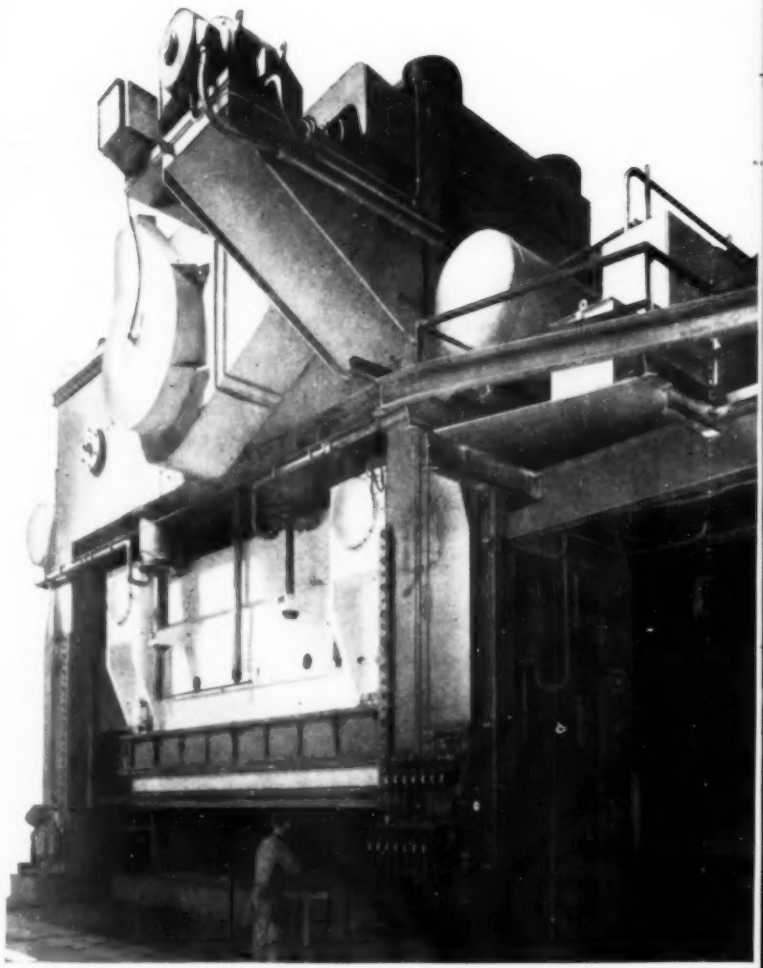
. . . as well as accessories and controls



DANLY 4000 TON STRAIGHT SIDE PRESS

Tonnage	4000 at 1/2" up; 2500 at 5" up		
Bed size	480" x 60"	Stroke	22"
Slide	480" x 42"	Strokes per minute	10
Shutheight	48"	Points of connection	4

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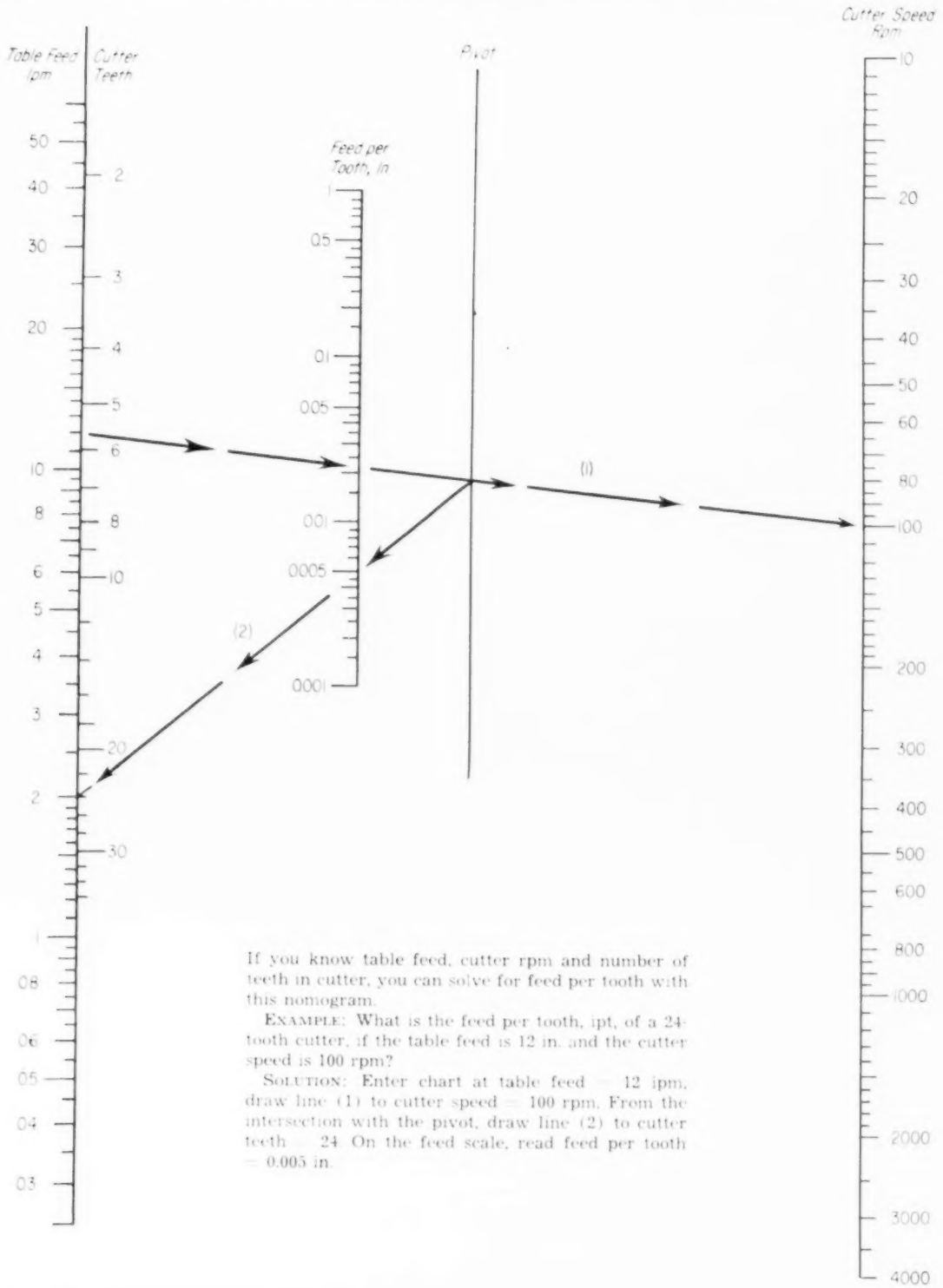
MECHANICAL PRESSES • DIE SETS • DIE MAKERS' SUPPLIES

Feed per Tooth in Milling

By Tyler G Hicks, mechanical engineer



If you know table feed, cutter rpm and number of teeth in cutter, you can solve for feed per tooth with this nomogram.

EXAMPLE: What is the feed per tooth, ipt, of a 24-tooth cutter, if the table feed is 12 in. and the cutter speed is 100 rpm?

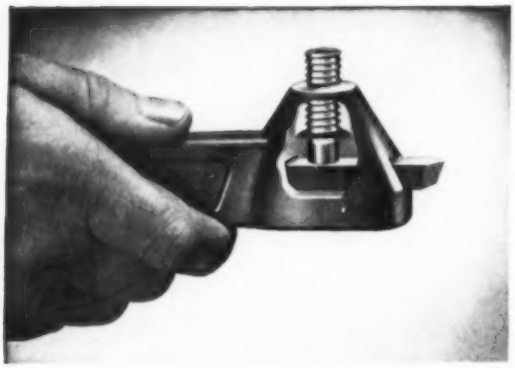
SOLUTION: Enter chart at table feed = 12 ipm, draw line (1) to cutter speed = 100 rpm. From the intersection with the pivot, draw line (2) to cutter teeth = 24. On the feed scale, read feed per tooth = 0.005 in.

◄ CIRCLE 261 READER SERVICE CARD

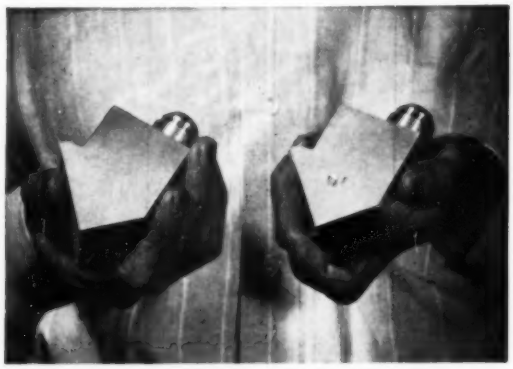
Practical Tooling Tips

NUMBER 1 OF A SERIES

Everyday more and more shops are using standard Vlier Tooling Accessories in place of custom-made devices for both tooling and original equipment applications. The precision construction, product uniformity and quick availability of these simple time-savers have made them tool room favorites. Why don't you start saving from their use?

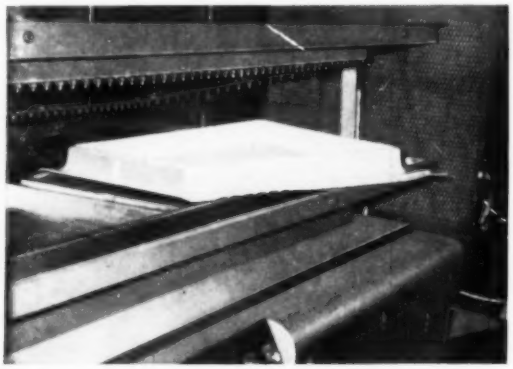


TO GET GREATER TOOL BIT RIGIDITY replace the tool holder screw with a Vlier Swivel-Pad® Clamp. The large, flat pad face provides many times more clamping area. Bits can be held tighter, reducing chatter and vibration. Small, narrow cut-off blades, multipoint tools, even stub ends can be rigidly held. Unique ball joint construction gives smooth angle adjustment in all directions.



EASY WAY TO STOP MARRING surface of part held in fixture. The part on the left was securely held in the fixture with a Vlier Swivel-Pad® Clamp. The scrapped part on the right was held with an ordinary set screw. With the Vlier Swivel-Pad® Clamp the pad stops at first contact with the part, screw torque is absorbed by a ball, preventing damage to the part. This exclusive ball joint construction also provides adjustment to off-angle surfaces.

SPRING PLUNGERS LET WRENCH DO MULTIPLE DUTY—The compression tool shown above is used to attach connectors to electrical wires. Formerly, each size wire connector required a different size tool. But now, through the use of Vlier Spring Plungers, one tool attaches all sizes of connectors—through the use of changeable jaws. The appropriate jaw for any size connector is easily inserted, accurately positioned, and held in place with a Vlier Spring Plunger.



THE RIGHT AMOUNT OF END PRESSURE AND NO MORE is what this spring plunger application calls for. More than 150 Vlier Spring Plungers are used to hold a plastic sheet in position during the forming operation of a plastic refrigerator door liner. Spring Plungers provide just the right amount of pressure to produce a perfect liner.

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Insist on Vlier Tooling Specialties...
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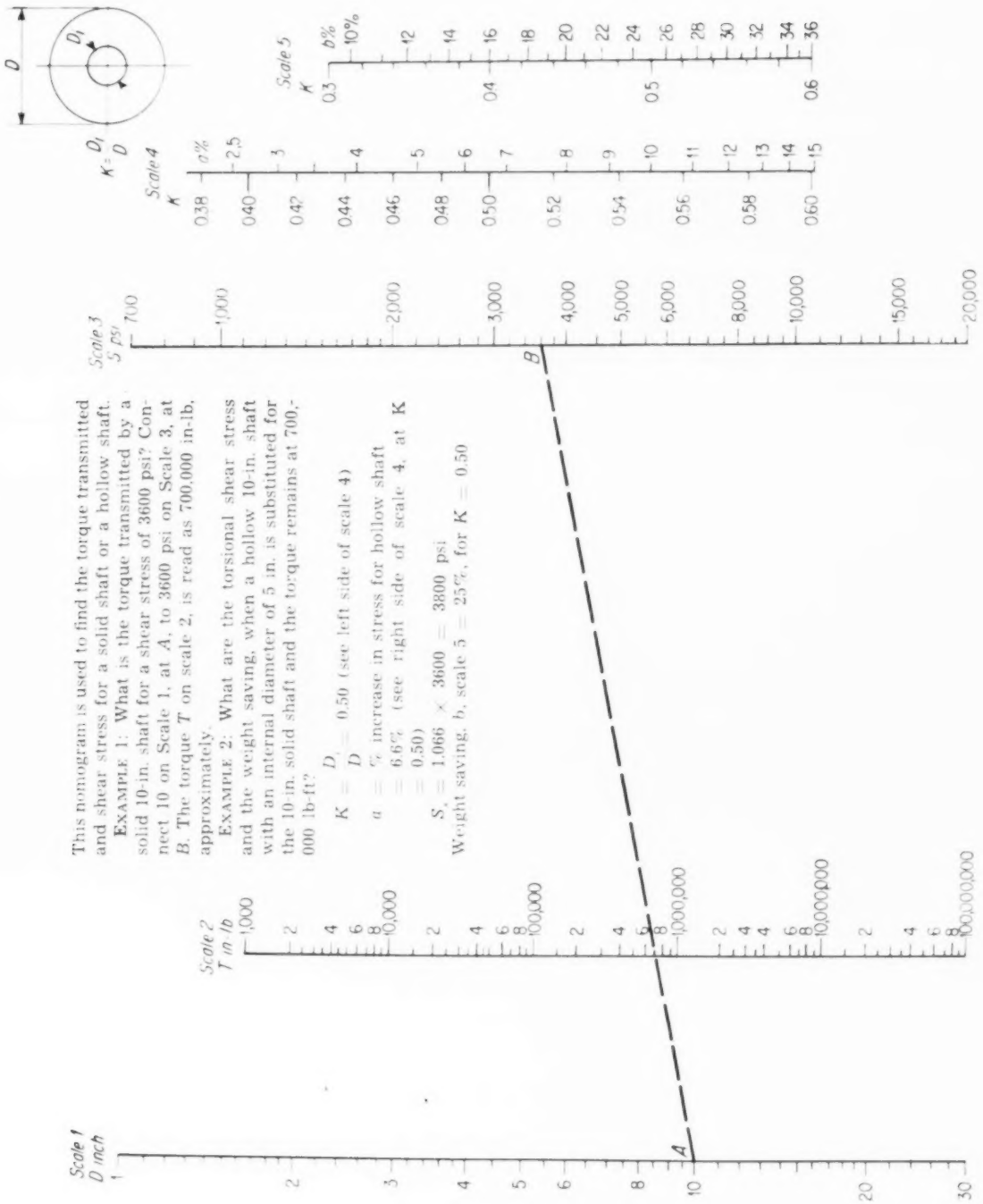
Torsional Loads on Shafts

Michael M Lachowski, Registered Professional Engineer, Corapolis, Pa



This nomogram is used to find the torque transmitted and shear stress for a solid shaft or a hollow shaft.

EXAMPLE 1: What is the torque transmitted by a solid 10-in. shaft for a shear stress of 3600 psi? Connect 10 on Scale 1, at *A*, to 3600 psi on Scale 3, at *B*. The torque *T* on scale 2, is read as 700,000 in-lb, approximately.

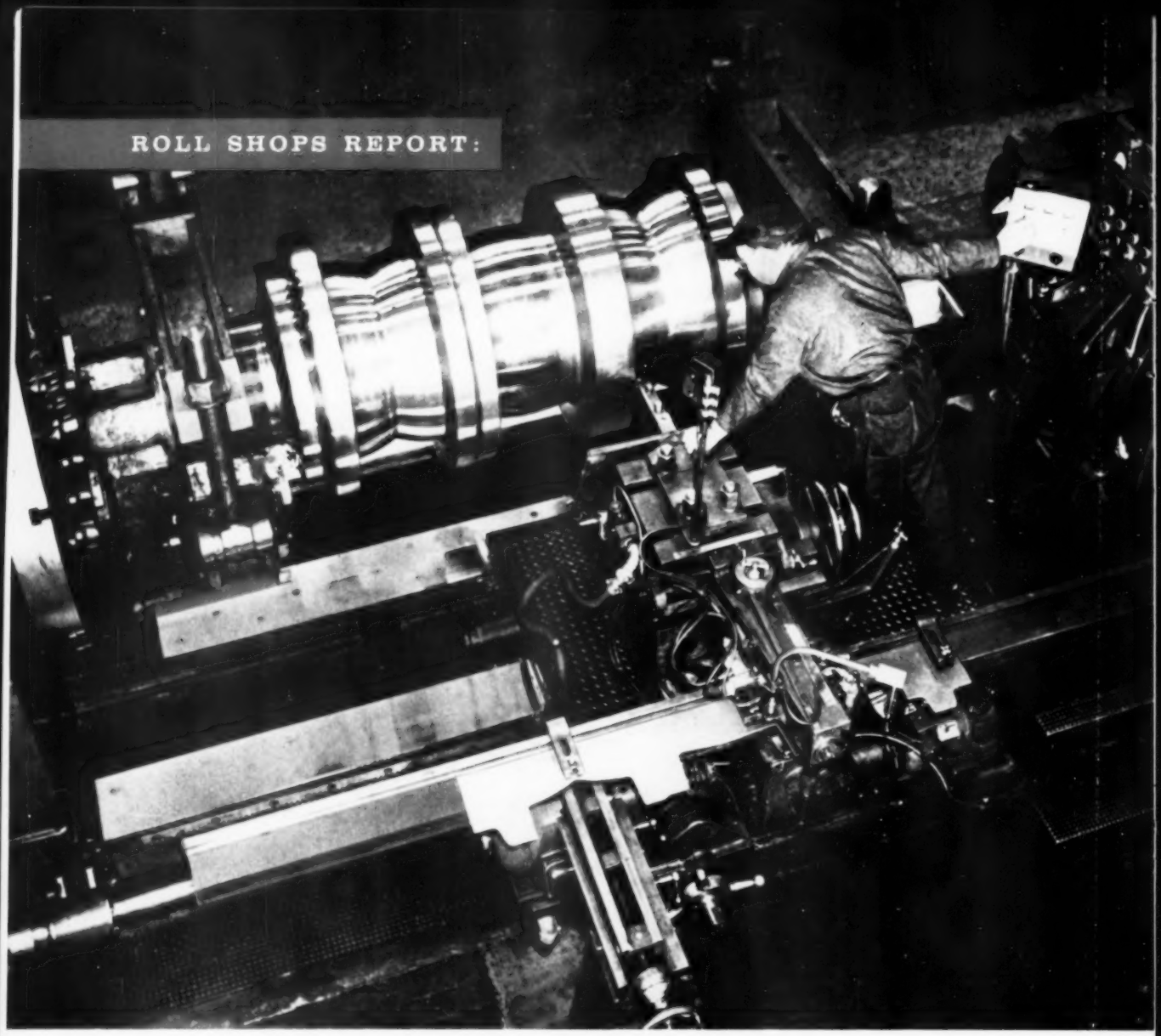
EXAMPLE 2: What are the torsional shear stress and the weight saving, when a hollow 10-in. shaft with an internal diameter of 5 in. is substituted for the 10-in. solid shaft and the torque remains at 700,000 lb-ft?

$K = \frac{D_1}{D} = 0.50$ (see left side of scale 4)

$a = \%$ increase in stress for hollow shaft $= 6.6\%$ (see right side of scale 4, at K = 0.50)

$S_s = 1.066 \times 3600 = 3800$ psi

Weight saving, b, scale 5 $= 25\%$, for $K = 0.50$



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Machine Tapers—IV

These data appear in an appendix to the proposed revision of the American Standard B5.10-1953 on self-holding and steep machine tapers. When approved the new standard will be published by the American Society of Mechanical Engineers, 29 West 39th St, New York 18, N Y.

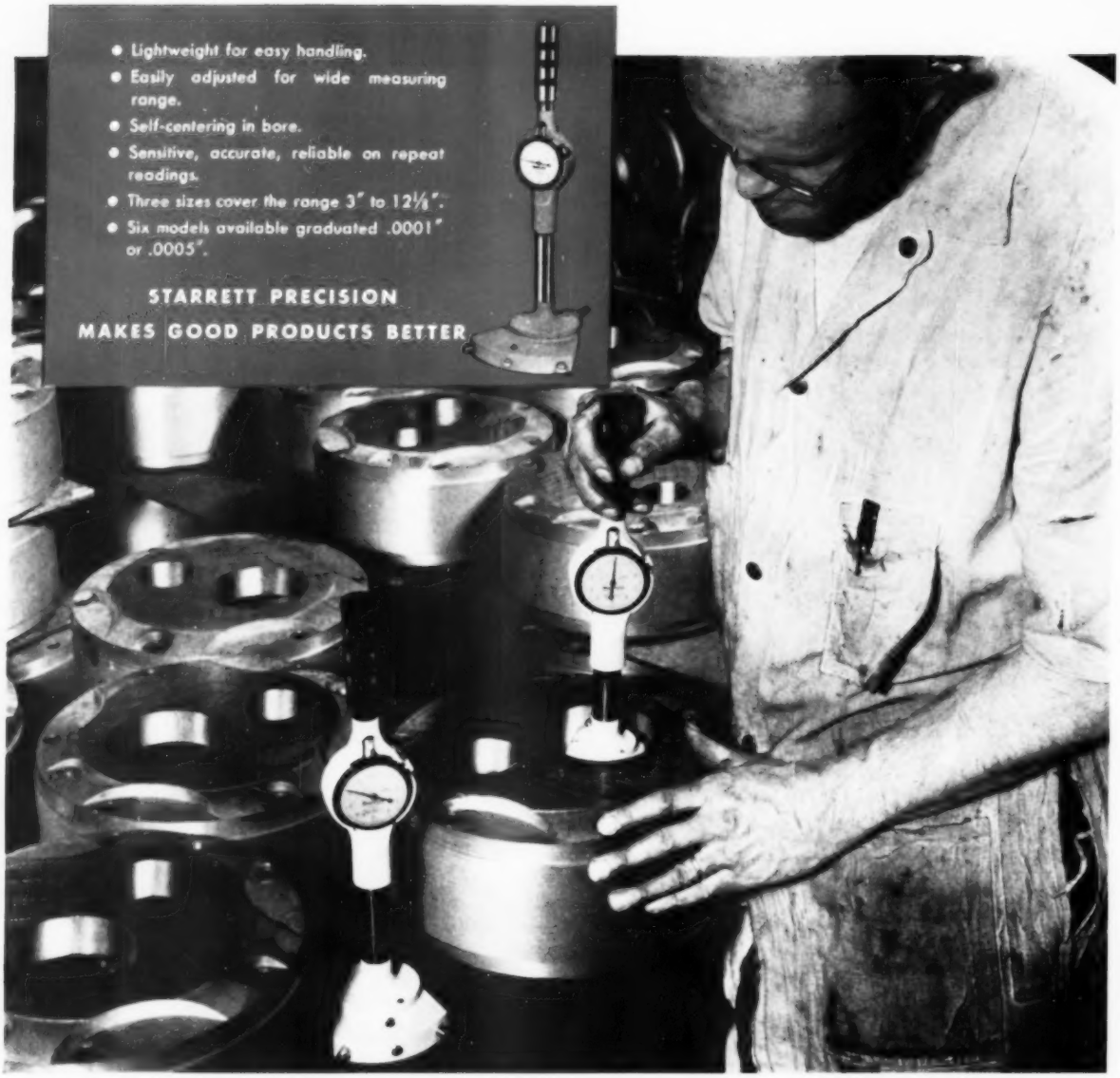
Morse Stub Tapers

No. of Taper	Taper per Foot[1]	Taper per Inch[2]	Diameter of Plug at Small End[3] D	Shank: Diameter at End of Socket[3] A	Shank: Total Length of Shank B	Shank: Depth C	Tang: Thickness E	Tang: Length F	Tang: Radius of Mill G	Tang: Diameter H	Tang: Radius J	Socket: Standard Plug Depth P	Socket: Min. Depth of Tapered Hole: Drilled X	Socket: Min. Depth of Tapered Hole: Reamed Y	Socket: End of Socket to Tang Slot M	Tang Slot: Width N	Tang Slot: Length O
1	0.59858	0.049882	.4314	.475	1 5/16	1 1/16	13/64	5/16	3/16	13/32	3/64	7/8	15/16	29/32	25/32	7/32	23/32
2	0.59941	0.049951	.6469	.700	1 11/16	1 7/16	19/64	7/16	7/32	39/64	1/16	1 3/16	1 5/32	1 7/64	15/16	5/16	15/16
3	0.60235	0.050196	.8753	.938	2	1 3/4	25/64	9/16	9/32	13/16	5/64	1 1/4	1 3/8	1 5/16	1 1/16	13/32	1 1/8
4	0.62326	0.051938	1.1563	1.231	2 3/4	2 3/16	33/64	11/16	3/8	1 3/32	3/32	1 7/16	1 9/16	1 1/2	1 3/16	17/32	1 3/8
5	0.63151	0.052626	1.6526	1.748	3	2 11/16	3/4	13/16	9/16	1 19/32	1/8	1 13/16	1 15/16	1 7/8	1 7/16	25/32	1 3/4

All dimensions given in inches.
[1]Taper per foot and diameter at end of socket (Col. A) basic dimensions.
[2]Taper per inch and dimensions in Column "D" calculated for reference only.

Tolerances

DIAMETER OF SHANK AT END OF SOCKET (A)
All sizes +0.002 −0.000
DIAMETER OF HOLE AT END OF SOCKET (A)
All sizes +0.000 −0.002


• Lightweight for easy handling.
• Easily adjusted for wide measuring range.
• Self-centering in bore.
• Sensitive, accurate, reliable on repeat readings.
• Three sizes cover the range 3" to 12⅛".
• Six models available graduated .0001" or .0005".
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Lightweight, wide range gages . . . *sensitive, accurate, easy to handle*

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Three sizes of these new Starrett No. 84 Series Dial Bore Gages will handle all bore diameters from 3 inches to 12⅛ inches (3"-5 3/16", 5"-8⅛", 8"-12⅛"). Available with Starrett high precision-low friction Dial Indicators reading in ten-thousandths or half-thousandths. Range screw, gaging contact and centralizing plungers normally furnished in hardened and tempered tool steel. Also available carbide tipped on special order.

Your nearby Industrial Supply Distributor will gladly demonstrate new Starrett No. 84 Series Dial Bore Gages . . . show you how they will save time, cut costs and improve accuracy on bore inspection and measurement. Call him for quality products, dependable service . . . or write Starrett for complete information. Address Dept. C, The L. S. Starrett Company, Athol, Massachusetts.

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Talking Shop...

Dilemma in Couplet

GOING THROUGH our office the last few weeks is a perceptive poem. The author is known, but the source is not, so we pay tribute and hope he won't mind our spreading his wisdom a little further.

The Executive's Dilemmas

If he's late for work in the morning, he's taking advantage of his position.

If he gets in on time, he's an eager beaver.

If the office is running smoothly, he's a dictator.

If it's not, he's a poor administrator.

If he holds regular staff meetings, he's in desperate need of ideas.

If he doesn't he doesn't appreciate the value of teamwork.

If he spends a lot of time with the boss, he's a back-slapper.

If he doesn't he's on his way out.

If he goes to conventions, he's on the gravy train.

If he doesn't he's not important.

If he tries to get more office personnel, he's a politician.

If he doesn't he's a slave driver.

If he's friendly with the office personnel, he's a politician.

If he keeps to himself, he's a snob.

If he makes decisions quickly, he's arbitrary.

If he doesn't he can't make up his mind.

If he works on a day-to-day basis, he lacks foresight.

If he plans ahead, he's a dreamer.

If he tries to cut red tape, he has no regard for system.

If he insists on going through channels, he's a bureaucrat at heart.

—Robert S. Herman

Thin Sheet Chatter

WHEN YOU FEED thin sheet into pinch-roll grinding and polishing machines it has a tendency to vibrate as it approaches and leaves the abrasive belt. This can leave chatter marks on the surface of the work. Behr-Manning's engineers licked the problem with simple sets of tapered nylon guides. The guides are $\frac{1}{8}$ in. thick and about 10 in. long, are clamped into an angle iron frame that holds guides above and below the work at right angles to the roll axis. Clamping the guides makes it easy to replace them and easy to adjust for different sheet thicknesses.

Deep Thought

"IF AN APPLE had fallen on Univac it might have blown a tube but it would never have come up with the law of gravity."

Explosive Plugs

NOW THAT NUCLEAR POWER is crowding explosives off the battlefield, they are turning up in the shop for forming, for machining, and for welding. The latest addition to the new applications is a report that in the Soviet Union open-hearth furnaces are tapped by an explosive charge set in the furnace plug. The plug has a conical shape with a coat of insulation inside to protect the explosive. Further insulation protects the detonator. Tapping time is said to be 50 sec compared with 25 minutes for hammers and 20 minutes the oxygen-blast pressure method.

MEMOS

by BESS RITTER

In all justification, the metalworker of today has more right than anyone else to "lose his temper." In Medieval France men engaged in making of fine swords discovered that different metals in combination, heated to the exactly right temperature, and then cooled off "just so" made the best of blades, and if any part of the process was "out of balance," the result could only be a blade that had "lost its temper."

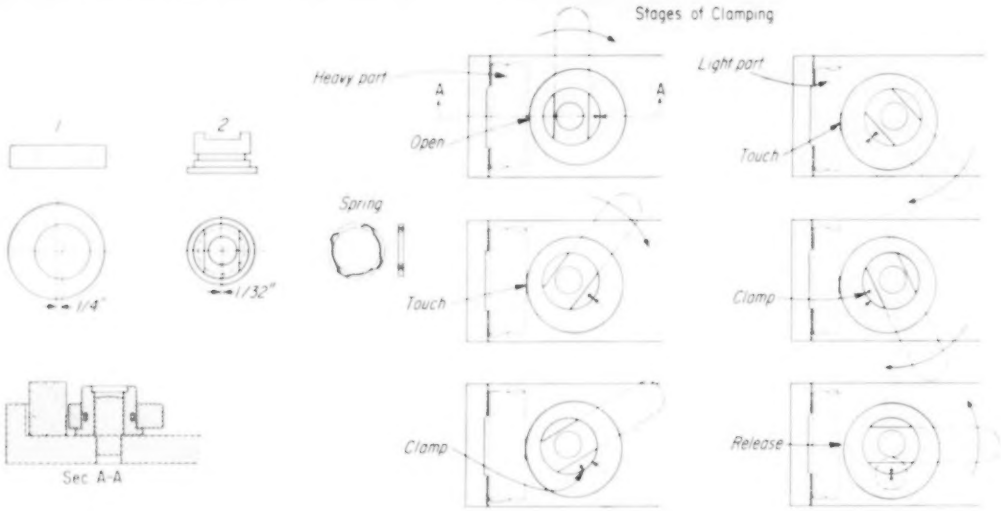
As time went by these astute workers, who also knew that people who became unduly angry were temporarily "out of balance" mentally, adapted the same phrase to describe this phenomena. Consequently, there were times when a French blade which had "lost its temper" resulted in a French metalworker who had "lost his temper" also!

A machine which operated exactly like an amusement park Ferris wheel was constructed for the baking of bread in America a few years before the outbreak of the Civil War: It was called a "reel oven," and the New England inventor, George Jennison, designed it with pans of bread in place of the Ferris wheel seats. The idea was for the machine to revolve, carrying dough, inside a large brick oven chamber, just slowly enough for the contents of the pans to be properly baked.

Mr. Jennison created an oven chamber to house his "reel," and it certainly was stupendous for its times: It was 35 feet high and extended all the way from the garret of a building to its cellar. But no matter how hard he tried, Mr. Jennison couldn't convince prospective buyers that the idea was sound: "There's no guarantee, he was told, as they watched the bread revolve, "that the pans won't fall off and spill their dough all over the machine and create a big mess." Ultimately the "reel" was sold, after its inventor went bankrupt, for the nice round sum of $100.

Practical Ideas...

Self-Adjusting Clamp Holds Dissimilar Parts



Most quick-acting clamps employed in drilling and milling jigs, and also in assembly fixtures, are quite suitable for clamping parts of identical shapes and sizes. However, when such parts as castings, forgings, and torch-cut pieces must be held, the usefulness of these clamps is limited.

Less limited are the clamps that feature some sort of adjusting device, but in most cases they have to be manually set. It can, therefore, readily be appreciated that a clamp with automatic adjustment would have a decided advantage.

The sketch shows a typical self-adjusting clamp designed to grip rough cast parts where a variation in sizes is expected. Part 1 is a 3½-in. dia disk with a 2-in. eccentric hole bored ¼ in. off center. The OD of part 2 has a sliding fit in the disk, and is turned with a ¼-in. wide by ⅛-in. deep groove to receive a friction spring. Eccentricity of the 1-in. bore in part 2 with relation to its OD is 1/32-in. The assembly mounts on a pin pressed into the fixture base.

The operating principle of the clamp is simple. As the clamp is rotated as a unit, because of the friction exerted by the spring, the disk contacts the work first. Further rotation causes the friction spring to slip, allowing the inside eccentric to produce the active clamping force. Leverage is applied with a handle fitted to a slot on the inside eccentric.

To release the workpiece, the handle is rotated in the opposite direction. Only the inner eccentric will move until it reaches its initial relative position with the disk, at which time pressure is removed and both parts will rotate in unison. Arrows are stamped on the faces of both parts to indicate their high points.

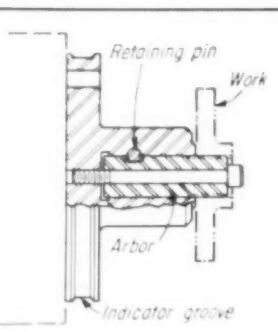
A K Das, production engineer, Dum Dum, India

Arbor Features Release

When performing secondary operations on work held on a threaded arbor, the work tends to jam against the shoulder, making part removal difficult. This problem is easily overcome with the tool shown.

It accepts a workpiece in a regular manner, by threading the piece onto the arbor and tightly pulling it up against the shoulder. Now, when machining has been completed, instead of applying some kind of leverage, pressure is released by loosening a capscrew and the part is spun off the arbor by hand.

The tool consists of a threaded arbor and a holder which bolts onto the face plate. Machining of holder



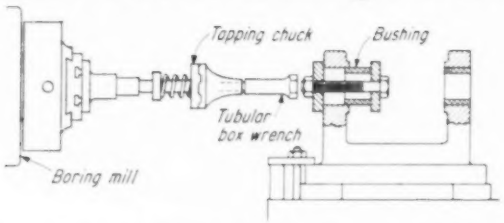
is carefully carried out to maintain concentricity between the bore and the periphery of the mounting flange. This periphery is turned to form a flat-bottom groove which serves as a recessed indicator surface to assure concentricity in future setups.

The bore is made to admit the arbor in a push fit, and a through hole in the bottom of the bore is tapped for a capscrew. When the arbor has been fitted and threaded to accommodate the workpieces, it is inserted in the bore and a retaining-pin hole is drilled—placing half its diameter in the arbor OD. The groove formed in the arbor is then widened to permit slight in-and-out motion.

Before each workpiece is mounted, the arbor must be made to contact the bottom of the bore. This is done by pulling up on the capscrew with a light final tightening.

F Murray, Chicago, Ill

Mill Powers Bushing Puller



When machining large castings or fabrications on the horizontal boring mill, it is sometimes necessary to press in a bushing into the bore just completed. This is to insure alignment when tolerances are close, or when there are two or more bushings that need final in-line boring to receive a shaft.

Unless special equipment is available, this usually means a long tedious job of pulling a wrench applied to a draw bolt. This method, though no doubt safe and sound, could better be described as "slow but sure" and has little to commend it should the operator have about a 4-in. length of 1¼-in. thread to pull by hand.

We have modernized the safe-and-sound method by taking the bull work out of it and letting the boring mill supply the power of pulling the wrench. The mill is fitted with a heavy duty tapping chuck in which the friction drive is adjustable. It is fitted on an adapter with a tubular box wrench long enough to take the bolt when the bushing is drawn in. The wrench is joined to the adapter with a pin.

To use this driver means that extra care should be taken to see that the bushing is squarely started in the bore. The regularly used heavy washers and draw bolt with nut are assembled through the bushing and bore. The tapping chuck is mounted in the boring-mill spindle and the chuck friction adjusted. This adjustment should be sufficient to give the necessary torque, but should allow the clutch to slip when overloaded. If the assembly pin is made of suitable diameter it will also serve as a shear pin to prevent damage by excessive load.

R J Gurney, Harpenden, Herts, England

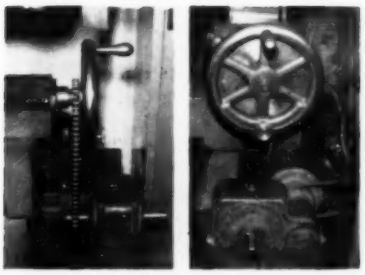
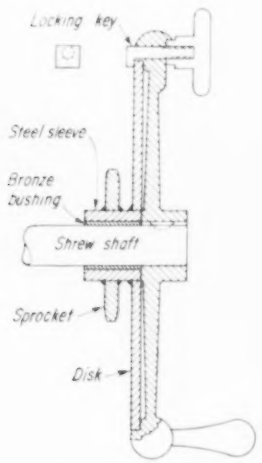


Table Feed Powered Independently

It has sometimes been necessary for us to build special-purpose machine equipment to achieve results not readily obtained on standard machines. One example of such equipment is a chain drive we use on the longitudinal feed screw on one of our machines. This arrangement allows us to power drive the table without sacrificing the hand or regular power feed. It can be operated independently, or in conjunction with other rotating members of the machine.

The sketch shows a sectional view of the handwheel attachment. It consists of a C R steel plate made to fit a recess bored in the back of the handwheel. A steel sleeve is welded into the concentric hole of the plate and fitted with a sprocket which is also welded in place. After the welding is completed, the bore of the sleeve is cleaned up and a bronze bushing is pressed in.



The bushing is then fitted to the screw shaft, and the plate to the recess, making sure that the plate will rotate freely. A screw, with a square key nipping the edge of the plate, is inserted through a hole drilled in the handwheel opposite the wheel handle. The front end of the hole is counterbored to provide a landing for a hand knob used in tightening the screw and engaging the drive plate.

Motor and reduction-gear box are mounted below the handwheel at the end of the machine as illustrated in the photo. Left section of photo shows the front view of the arrangement with a chain linking the gearbox sprocket to the drive plate. Right side of photo is the end view.

H C Haag, Hohokus, N J

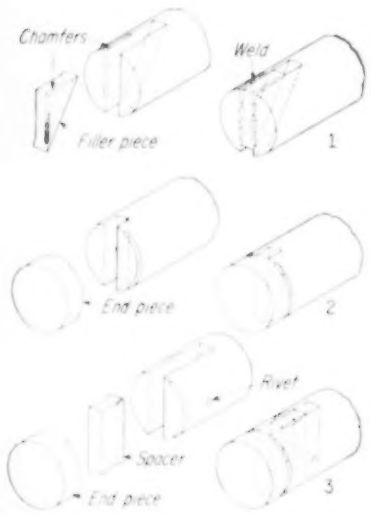
Washer Makes Finger Guard

The painful experience of pinching a finger between the gear teeth of a chuck key and the chuck body can be avoided by installing a guard on the key.

A guard is made by boring up a standard steel washer to fit tightly on the body of the key. To install the washer, the T-handle is first pressed out. The washer is then pressed onto the body, up against the gear-teeth section. After the handle has been replaced, the improved key is ready for service.

H J Gerber, Stillwater, Okla

Practical Ideas...



How to "Mill" a Square Hole

Here is an easy way of producing a square tool hole in a boring bar. It differs from the old method of first drilling a round hole which is then either filed square or broached in that it involves but a simple milling operation and welding.

As the sketch shows, an accurate square hole is produced by milling a slot in the end of the bar, at an angle or squarely across, and then closing the open end with a filler piece.

Three methods of tool mountings are shown. The first is the popular 45° angled hole. This is made by fitting a triangular piece into the slot after it has been cut. Liberal chamfers are provided where weld is to be applied.

The second is a bar with a 90° tool position. Here the slot is milled to the exact depth required with allowance for tool clearance. An end piece of the same diameter as the bar is welded over the slot to complete the hole.

In the third example the procedure is the same as in the second with the exception of the depth of the slot. In this case the slot is deep enough to accommodate two tools plus a spacer which is secured with rivets in addition to welds for increased strength. A toolbit is used as gage to position the spacer and filler piece.

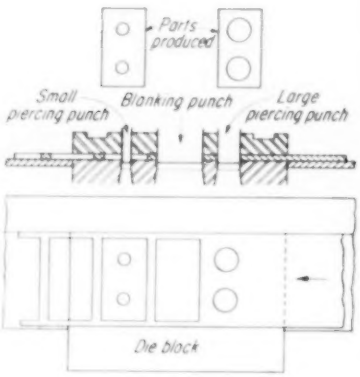
To avoid unnecessary filing in cleaning up the holes when finished, the welds should begin and end away from the corners. Putting the finishing touches to the bar includes a clean up cut over the bar and drilling and tapping holes for setscrews.

J McQueenie, Ayeshire, Scotland

Die Generates Dissimilar Parts

We recently had to tool up for the production of a large number of stampings. The parts were plain enough, but the total output had to be divided into two quantities which differed only in the size of the holes to be pierced.

Two samples, shown at the top in the sketch, illustrate the basic difference in the parts. Outside dimensions are alike, but the part at left requires ¼ in. holes while the other gets ½ in. holes. This would ordinarily take two dies to accomplish,



and it would also mean double tooling expense, a factor we had to take into account.

Consequently, our aim was to construct a tool that would produce both parts. We did this with the die shown. It incorporates all punches necessary; the small set on the left side, and the large on the right with the blanking punch centered between them. Stops and punch pilots are not shown, but these will have to be interchangeable.

When feeding the strip stock from right to left, the parts with the large holes are produced. After the required number has been reached, the stock supply is simply placed on the other side of the press and fed into the die from left to right to get the parts with the small holes. It's as easy as that.

Edwin Achinelli, Buenos Aires, Argentina

R B Courtney
Whittier, Calif

$25 In addition to regular payment for his idea:

HOW TO DIVIDE A CIRCLE

in the Dec 15, 1958 issue

An extra $25 will be paid for the best Practical Idea in each issue of *American Machinist*. Selection of the winner is made by a group of our readers.

PAYMENT—$25 in addition to regular rates for the items published to be paid as soon as reader votes are received—usually three to four weeks after the date of issue. The winner will also be announced in these pages as soon thereafter as practicable.

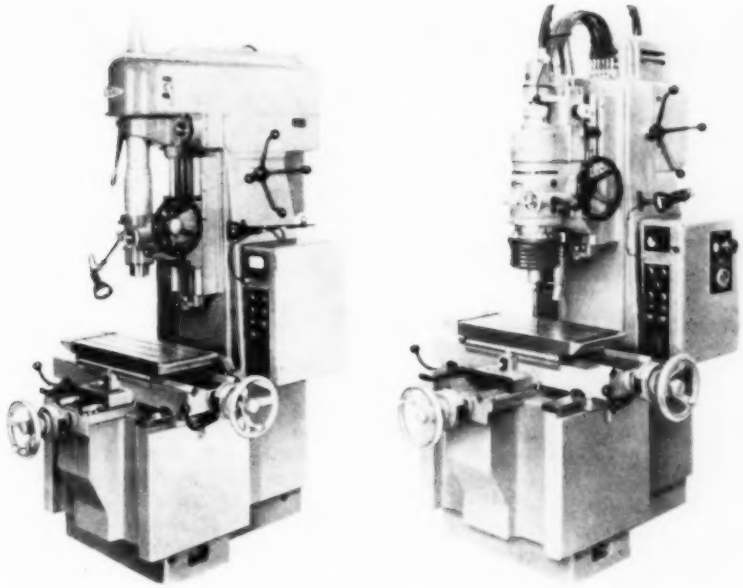
JUDGES—A group of 200 *American Machinist* readers is asked to select preferred articles in each issue. The group is a true cross-section of all readers, and changes entirely each time. Their votes, in addition to guiding the editors, select the best Practical Idea. If at any time their votes result in a tie, $25 will be paid to each co-winner. Decision of the readers will be final in each case.

REQUIREMENTS—Only items in the Practical Ideas pages are eligible, and they must be submitted directly by the originator. Do not worry about your shortcomings as a draftsman, photographer, or author—every item will be edited in accordance with *American Machinist* standards and suitable illustrative or explanatory material added where needed. Readers will judge only the finished product—in terms of its usefulness to them.

WHO MAY ENTER — Anyone may enter except employees of the McGraw-Hill Publishing Co, Inc, and those of advertising agencies or departments. Suggest to your employees that they submit ideas.

HOW TO ENTER — Send all entries to "Practical Ideas Editor," American Machinist, 330 West 42nd St, New York 36, N.Y.

New Shop Equipment
Materials and Parts



Moore's Jig Borer and Jig Grinder Team Provides Accuracies to Split-Tenths

The No. 3 jig borer (left) and the No. 3 jig grinder (right), latest additions to the company's line of precision toolroom machines, provide greater capacity and greater precision than their predecessors, the No. 1 and No. 2 machines. Both of the new units are capable of split-tenth accuracy. This advance beyond the former limit of accuracy, the tenth, is made possible by closer locational tolerances built into the machines.

The jig borer is designed for boring, drilling, reaming and spotting holes in dies, jigs and production parts. It features hardened, ground and lapped steel ways that eliminate gibs and overhang; a speed range of 60 to 2250 rpm; an 11 x 24-in. worktable surface, with 20 13/16-in. height allowance; centralized controls for spindle speeds and feeds; and micro setting of the vernier dial.

The jig grinder has a spindle speed range of 40 to 250 rpm, permitting faster strokes for chop-grinding; an 11 x 24-in. worktable surface, with 18-in. height allowance; more accessible cross clamping; micro setting of the vernier dials; hardened steel ways; and all the other features of the jig borer.

Positioning accuracy of the machines is shown in tabular form. The jig borer has a spindle housing travel of 12 in. and a spindle travel of 5 in. The jig grinder has a spindle housing travel of 13 in. and a spindle travel of $3\frac{5}{8}$ in.

Moore Special Tool Co, Inc, Bridgeport 7, Conn

Positioning Accuracy

Longitudinal travel:	
Greatest error in any inch	30 millionths
Greatest error in 18 in.	90 millionths
Cross travel:	
Greatest error in any inch	30 millionths
Greatest error in 11 in.	90 millionths
Squareness:	
Compound slide	60 millionths
Travel, spindle housing	90 millionths
Travel, spindle	90 millionths

MORE DATA? Circle 51, inside back cover

Vinyl-Coated Steel Can Be Deep Drawn, Stands Elongation of 30%

Vinyl-coated steel, the latest development of United States Steel, combines the strength of steel with the decorative and functional aspects of vinyl plastics. Basically, production of vinyl-coated steel in sheets and coils involves curing and bonding of liquid plastisols to the steel in a continuous mill coating process. Prior to cooling, the coating can be embossed with any texture that can be engraved on a printing roll.

Versatility of the new product can be judged from the variety of parts illustrated. Fabrications ranging from flat work to deep drawing are well within the workability range of the new steel. It can stand elongation of at least 30% without damage, and little or no post-fabricating processing beyond cleaning is required.

The liquid vinyl is applied in coatings ranging from 0.008 to 0.020 in. thick, in increments of 0.001 in. Color is matched to customer specifications. Hardness of the coating ranges from approximately 60 to 90 Shore A Durometer.

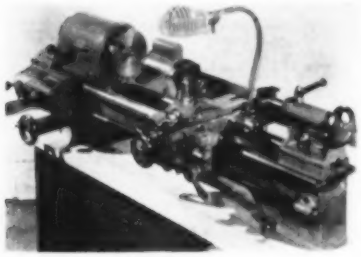
The steel sheets are available in gages from 18 through 28. Widths range from 24 to 52 in., lengths from 30 to 144 in. It can also be supplied in coils. The coated material can be sheared, slit, punched, lock seamed, stamped, drawn or roll formed without damage to the coating or change in color. It can also be welded. But,

since vinyl is an insulator, current flow must be controlled from the back side. Four welding techniques have been applied successfully to vinyl-coated steel sheets: Graham stud welding, projection welding with capacitor discharge, spring-loaded electrode welding, and magnetic force welding. All the standard mechanical fasteners can be used, as can the adhesives.

The material is heat resistant (up to 160 F continuous), scuff and abrasion resistant, stain resistant, and should find wide application in automobile interiors, appliance cabinets, architectural products, railroad car and bus interiors, office and institutional fixtures, and furniture.

United States Steel Corp, 525 William Penn Place, Pittsburgh 30, Penna

MORE DATA? Circle 52, inside back cover



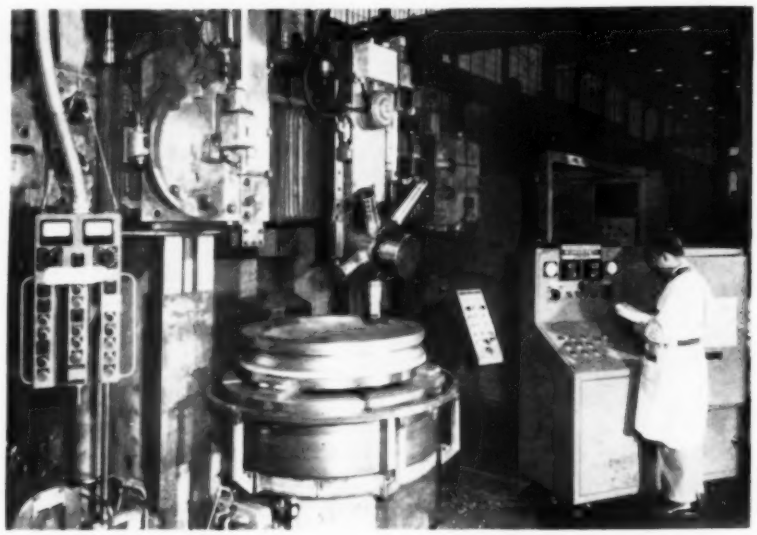
Delta 10-in. Metal Lathe Has ¾-in. Collet Capacity

Model incorporates variable-speed drive that provides the advantages of infinitely variable speed from 50 to 1500 rpm plus the high torque transmitting power of matched V-belts in the final drive to the spindle. Smooth, quiet direct drive position can be used extensively—for many thread pitches and heavy cutting usually done in gear drive or other lathes.

The ¾-in. collet capacity, said to be larger than any other lathe in its class, is obtained by using a 4-C style collet with a 15/16-in. hole through the spindle. Additional features include a massive, double row, preloaded, inboard spindle ball bearing, sealed against dirt and lubricated for life; quick change gear box that provides a choice of 54 feeds or thread pitches. Lathe is used with a ¾-hp motor and optional bench with adequate space for separate mounting of the motor. Price, without bench, motor and switch, is less than $700.

Rockwell Mfg Co, Delta Power Tool Div, 451 N Lexington Ave, Pittsburgh 8, Penna

MORE DATA? Circle 53, inside back cover



G&L Introduces Magnetic-Tape-Controlled Vertical Boring and Turning Mill

Reported to be the first application of magnetic-tape path control outside the aircraft industry, this 54-in. vertical boring and turning mill is being delivered to Gray Tool Co, Houston, Texas, for contour machining of valve bodies. The basic machine is from G & L's recently redesigned line of VBM's in standard sizes from 54 in. to 14-ft table diameters.

The machine is equipped with a 5-position right-hand turret head with power indexing, and a left-hand swiveling-ram-type tail head. Feed and traverse of turret head, ram and saddle can be controlled by tape or from the pendant. (Tape control of the left-hand head was not called for, but can be provided.)

Numeripath control

The Numeripath control system includes a Numericord (G&L) director, a magnetic tape recorder, and a control console with tape playback unit. The director interpolates programmed data from a punched paper tape and transmits electrical impulses to the recorder. The permanent recorded tapes are then used to operate the machine.

Provisional stops for inspection of work or tool can be programmed as required. Playback stops can also be provided for taking a second cut on a contour when required for greater depth. In this case the tape is run back to the beginning of the cut and replayed.

At any time during the operation, the machine can be placed under manual operation. A remote electronic measuring system for ram and saddle motions permits the operator to check tool position on decimal readout indicators located on the control console.

Constant cutting speed

A constant cutting speed control in conjunction with a 50-hp adjustable voltage drive provides constant sfpm operation over a wide range of diameters. The table changes speed automatically without stopping and while the tool is in the cut. Two infinitely adjustable speed ranges are provided on this unit: 2.3 to 41 rpm, and a high range of 9 to 180 rpm.

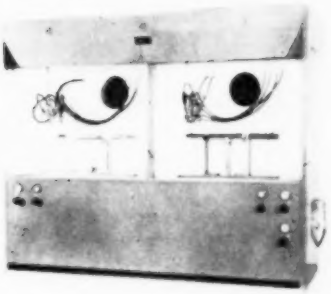
For manual operation, pushbutton pendant control is provided at any point within the operator's working range. Control from the pendant includes rail elevating and clamping, table speed selection and shifting, engagement of constant cutting speed, traverse and feed direction, power chucking, and emergency stop. Also included is selection of 16 feeds from 0.003 to 0.500 ipr.

Computing and tape recording are relatively rapid operations. One Numericord director can produce in 15 minutes sufficient tape to operate a machine for one hour.

The VBM's are also available with punch-paper-tape discrete positioning Numeripoint control.

Giddings & Lewis Machine Tool Co, Fond du Lac, Wis

MORE DATA? Circle 54, inside back cover



Automatic Spray Machine Designed To Speed Low-Cost Job Production

This double vertical fixture automatic spray machine, air operated and housed in its own booth, is designed for high production painting of low-cost jobs.

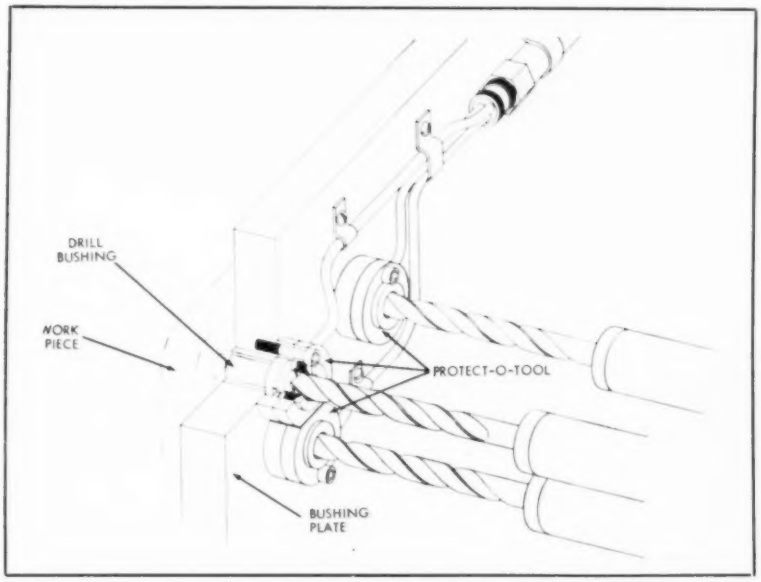
An increase of 200 to 500 pieces per hour is claimed on jobs requiring fast, perfect finishing of one to three surfaces of generally oval or rectangular shape, where fine mask definition and paint demarcation are important.

The operator unloads and loads one station while the machine is painting in the other, thus eliminating lost operator time and making the equipment suitable for use with a fast conveyor.

Machine illustrated measures 96 in. long by 36 in. wide by 79 in. high.

Conforming Matrix Corporation, 321 Toledo Factories Building, Toledo 2, Ohio

MORE DATA? Circle 55, inside back cover



Electronic Tool-Sensing Device Cuts Transfer Machine Cost, Reduces Scrap

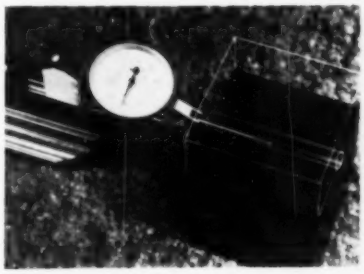
Designated Protect-O-Tool, this electronic tool-sensing device eliminates separate probe and inspection heads and stations, prevents processing of scrap parts and, by signalling the control panel and shutting down the machine when a tool breaks, prevents additional tool damage.

Mounted on bushing plates behind the regular drill bushing hole, the device senses the presence or absence of a tool, or even a part of a tool in cases where a small piece of a drill or tap breaks off and remains in the workpiece. Tool detection occurs as the tool passes through the detector before and after machining.

The manufacturer sees the greatest cost savings coming from the elimination of machining operations on scrap parts, especially on lines where probe and inspection stations are widely separated in the line. In a line where the check stations are 20 stations apart, a tool break in part of the first station after inspection could result in the machining of 19 scrap parts before the broken tooling is detected. The Protect-O-Tool device would shut the machine down when the tool breaks.

Cross Co, 17801 Fourteen Mile Rd, Detroit (Fraser), Mich

MORE DATA? Circle 57, inside back cover



Long-Contact Test Indicators Speed Deep Hole Exploration

Four new models have been added to the company's Series L Testmaster line. In addition to providing long range and high magnification, these models, known as the L-15, L-16, L-19 and L-20, are equipped with extra-long contacts for deep hole exploration in jig borer and surface plate applications.

The 0.080-in. ball-tip contacts are either 1.446 or 1.497 in. long, depending upon the model. All models are graduated in 0.0005-in. increments, have a total range of 0.080 in. (eight revolutions), and are available in either horizontal or perpendicular styles with either regular or large ($1\frac{1}{2}$-in.-dia) dials.

Federal Products Corp, 1144 Eddy St, Providence, RI

MORE DATA? Circle 56, inside back cover

Work is Placed on Top of Optical Flat in New Inspection Unit

The Cartrilamp is a monochromatic light source which, when used with the company's new, coated Centriflat optical flats, shows surface flatness at a glance. The inspection technique increases speed and accuracy and reduces handling of the flats. The work to be checked is placed face down on the top of the Cartiflat, not under it. The flat remains mounted on the table at all times. Just place the part on the flat, check it in the viewing mirror, and the inspection is completed.

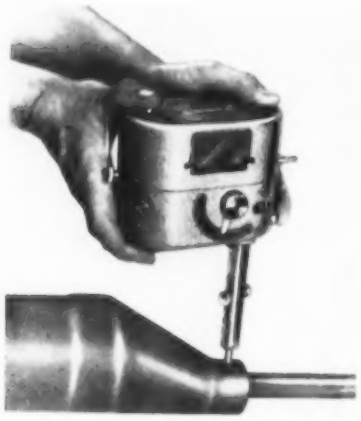
The large, 10-in.-diameter optical

flat permits many parts, of varying size and shape, to be checked simultaneously. Special flats are available. Flats are coated with a high-efficiency coating which increases the reflectivity in some areas and decreases it in others. It also concentrates the helium light on the work surface. As a result, the interference bands are clear, bright and easy to read, even on dull-lapped parts such as brass and soft steel.

The Cartrilamp is contained in a specially designed carrying case, measuring 24½ x 14⅝ x 17⅛ in.

Cartriseal Corp, 3515 W Touhy Ave, Lincolnwood, Ill

MORE DATA? Circle 58, inside back cover



Mechanical Instrument Measures And Records Vibrations

Designated the Hand Vibrograph, this compact, light weight (less than 5 lb) instrument magnifies and permanently records frequency, amplitude and waveform of vibrations and other mechanical motions. It is claimed to be the only such instrument available with both ink and waxed paper recording, and a tape take-up reel for convenient storing of readings. It also provides variable tape speed to simplify reading at high frequencies.

Designed for simplified scheduling of machinery maintenance (by comparing the vibration amplitude at installation to later readings), the Vibrograph can also be used to measure speed of rotating equipment where shafts or rotors are not accessible by simply placing its probe against the machine housing.

Instrument has a frequency range of 0 to 20,000 cpm; an amplitude range of 0.0004 to 0.800 in.; magnifications of 2, 4, 5, 10 and 20X; and tape speeds of 70 to 275 ipm. It weighs 4¾ lb and comes complete with a full line of accessories, all in a mahogany carrying case, at a cost of $475.

The Korfund Co, Inc, 49-39B 32nd Pl, Long Island City 1, NY

MORE DATA? Circle 59, inside back cover

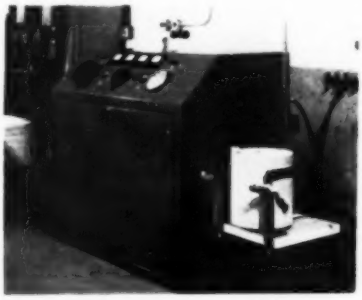
Attachment Turns Electric Hand Saw Into High-Production Chop Saw

Made of high-strength, heavily ribbed alloy castings, the CTD chop saw attachment quickly and easily converts electric hand saws into high-production chop saws for cutting nonferrous metals, plastics, wood, rubber and other materials. For miter cuts, the attachment is calibrated 0-45° on either side of the centerline. An 8¼-in. blade cuts 2 x 5¾ in. at 90° or 2 x 4 in. at 45°.

Base of the unit is 18 x 19½ in. with the fences in folded position and 18 x 34 in. in extended position. Unit weighs 24 lb.

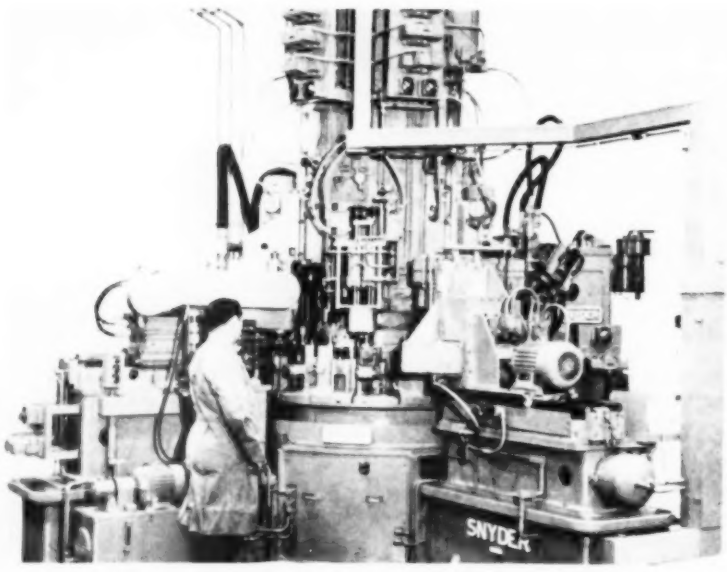
Commercial Tool & Die Co, 2315 Jesse St, Los Angeles 23, Calif

MORE DATA? Circle 60, inside back cover



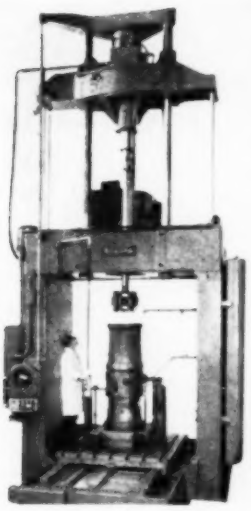
INDUCTION MELTING UNIT, the Integral 30, features a 30-kw motor-generator set, a compact high-frequency transformer, all necessary capacitors, meters and controls for operating high-frequency induction furnaces and coils—*Inductotherm Corp, 412 Illinois Ave, Delanco, NJ*

MORE DATA? Circle 61, inside back cover



CAST-IRON AND ALUMINUM PUMP BODIES are processed on this Snyder special center-column machine at a rate of up to 100 parts per hour. Using a double-index system with two-position fixtures, the compact machine handles a variety of similar parts having differences in locations and sizes of holes. Differences in part materials are accommodated by providing all machining heads with change gear boxes—*Snyder Corp, 3400 E Lafayette Ave, Detroit 7, Mich*

MORE DATA? Circle 62, inside back cover



Vertical Honing Machine Finishes Large Bearings, Cylinder Liners

Model 8530, a heavy-duty single spindle vertical honing machine, hones 14-in. to 19.5-in. dia, 70-in. long cast-iron cylinder liners. Stock 0.010 in. to 0.020 in. is removed and a finish of 7 to 32 rms is produced.

The machine has a capacity ranging up to 36-in. dia and 72-in. length. It is equipped with a 30-hp motor on the head and a 20-hp motor on the hydraulic unit. Spindle stroke is 80 in.

The model illustrated has been installed at Ingersoll-Rand for honing large bearings, cylinders, cylinder liners, marine and diesel parts, and compressor cylinders.

Barnes Drill Co, 830 Chestnut St, Rockford, Ill

MORE DATA? Circle 63, inside back cover

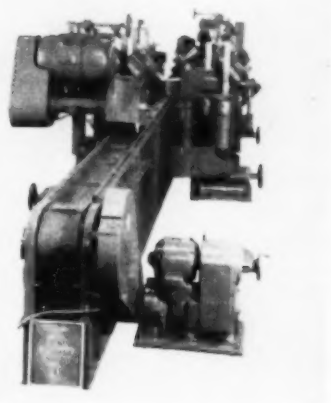
Universal-Positioning Toolholder Speeds Machining Operations

Use of the Throway carbide toolholder eliminates need to change holders from right hand to left hand or straight during a sequence of operations. In addition, when indexing the insert, it is not necessary to disturb the setup by removing the holder. Only the cap assembly is loosened, the carbide indexed, and cap retightened. Holder remains on center of the work. Positive-rake carbide inserts can be indexed four times. Cap assembly carries an adjustable, replaceable carbide chip breaker that may be indexed four times.

Any grade of carbide required may be used. High-speed square or round toolbits or boring bars can also be used with addition of a standard clamping cap.

Maxwell Industries, Inc., 493 E Fifth St, Ashtabula, Ohio

MORE DATA? Circle 64, inside back cover



Devine Introduces Straight-Line Conveyor for Polishing, Buffing

Designed for use with Type V and L polishing, buffing and brushing heads, this sturdy, universal straight-line conveyor is built in sections, of welded structural steel. The standard loading section is 7 ft long, the unloading section is 6 ft long, and intermediate sections are made in 5- and 10-ft lengths. Available in 4-, 6-, 10- and 12-in. belt width, the conveyor uses heavy-duty, one-piece, stretch resistant belts.

Standard conveyor height from floor to belt face is 34 in. Standard riser blocks can be supplied to increase the height to 40 in. The conveyor drive unit, a motor with variable-speed transmission, is mounted at the unloading end of the conveyor. Connection to the pulley drive shaft is through an enclosed roller chain drive.

Divine Brothers Co, Seward Ave, Utica, NY

MORE DATA? Circle 65, inside back cover

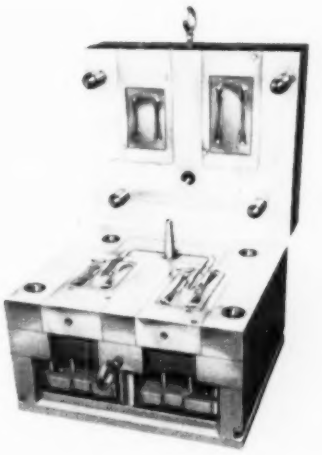
6000-8000-lb-Capacity Lift Trucks Offered in Pneumatic-Tire Series

New series of 6000, 7000, and 8000-lb-capacity units, Models 60, 70, and 80, has been added to the Challenger line. Narrow width of single drive wheel design, plus short turning radius and power steering, permits use of these units in standard, single door boxcars. Dual wheels are optional on all three models.

Trucks are powered with 6-cylinder, 70-hp Continental engines that develop 168 lb-ft of torque at 1200 rpm. Lifting speed is up to 66 fpm; operating speeds are up to 17 mph. Newly developed two-speed power shift Hystamatic transmission is available on all models as optional equipment.

Hyster Co, 1003 Myers St, Danville, Ill

MORE DATA? Circle 66, inside back cover



Unit Die Handles Double-Impression Molds in Vertical Position

The Master Mold unit die can handle double-impression molds in the vertical position. This means that either or both molds can be changed in

a matter of minutes from the top by using an eyebolt and hoisting equipment. It eliminates the manual handling ordinarily required in multiple-impression setups, and permits the molding of larger products.

The basic design was made for zinc and especially aluminum die casters who can shoot the molten metal in the lower position.

Richards Tool & Mold Co, Racine, Wis

MORE DATA? Circle 67, inside back cover

Screwdriver—Nut Runner Features Automatic Starting and Stopping

The Clecomatic screwdriver—nut runner is reported to provide unprecedented speed and economy in production fastening jobs. Outstanding feature is a mechanism that turns on the air motor, then automatically shuts it off when the screw or nut is fully torqued. Because the air motor runs only during actual rundown, less air is used and there is less tool wear.

Two models are available, both with a capacity of ¼-in. free-running or No. 10 self-tapping screw. The non-reversing model has a speed of 950 rpm, is 10 5/16 in. long, and weighs 2 5/16 lb. The reversing model has a speed of 700 rpm, is 11 13/16 in. long, and weighs 2 15/16 lb. Both have a ⅛-in.-NPT connection.

Cleco Air Tools, Box 2119, Houston, Texas

MORE DATA? Circle 68, inside back cover

Swiss Precision Caliper Measures Offset Surfaces

Major feature of this caliper is the swing jaw which has a hinge that allows it to rotate a full 180° in a plane parallel to the measuring surface of the jaws. Design permits measuring distances between two points situated on different axes and eliminates necessity for using height gages. Part can be measured while it is being machined.

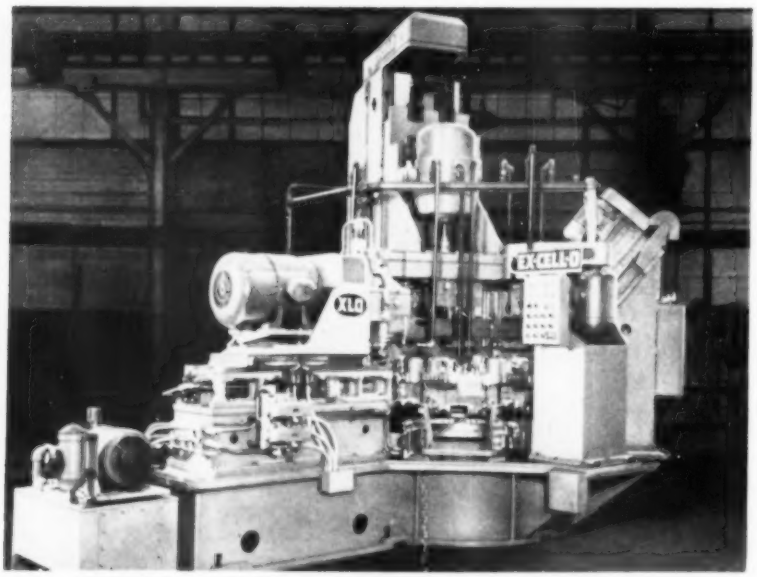
Instrument is scaled with graduated digits for reading to within 0.001 in. In addition, there is an angular measuring scale located on the pivot point of the lower jaw for checking angles between various axes. The 10-in. size model is priced at $79; other sizes range in price from $39.

Imported by American & Overseas Trading Co, 667 W 161st St, New York, NY

MORE DATA? Circle 69, inside back cover

DEMAGNETIZER provides low-cost demagnetization for ferrous parts such as cutters, drills, gears and similar parts as well as for small production runs. The top plate measures 7 x 9 in. Unit operates on 220-v ac and draws 15 amps; it may be operated on a 25% duty cycle—*O S Walker Co, Inc, Worcester, Mass*

MORE DATA? Circle 70, inside back cover



OIL PUMP BODIES are machined at the rate of 68 pieces per hr on this custom 8-station rotary index machine. Machining operations are performed on both sides of the pump body and include spotfacing, milling, drilling, tapping, reaming and core drilling. The material is cast iron. The machine table is arranged with a set of eight 2-position workholding fixtures—*Ex-Cell-O Corp, 1200 Oakman Blvd, Detroit 32, Mich*

MORE DATA? Circle 71, inside back cover

Carbon-Resistor Tube Furnaces Provide Temperatures to 5000 F

Temperatures to 5000 F can be rapidly reached and closely controlled throughout the heated length of these carbon-resistor tube furnaces, which are available in six standard sizes ranging from 1 in. x 12 in. to 5 in. x 48 in. (Dimensions refer to internal heated length.)

Close control and regulation of furnace temperatures are assured by

V-R TANTUNG®

Designed for cutting speeds between high speed steel and carbides

SOLID TOOL BITS
•
CUT-OFF BLADES
•
CAST-TO-FORM
•
TIPPED TOOLS

V-R TANTUNG bridges the gap between maximum cutting speeds of high speed steel and practical minimum speeds of cemented carbides . . . and it's easy to grind with aluminum oxide wheels.

High red-hardness; high transverse rupture strength; low coefficient of friction and high shock resistance are a few of the characteristics which make TANTUNG cast alloy the ideal tool material for intermediate cutting speeds.

Ask your V-R representative to show you how TANTUNG can cut costs on many of your machining operations. He will also be glad to give you full information on V-R Ceramic and Carbide cutting tools for your higher speed jobs.

"Where and How to use TANTUNG" —

Facts about all types of TANTUNG tools . . . how to grind and braze . . . examples of production cost-savings, etc. Ask for Booklet No. 573.

Vascoloy-Ramet corporation

PRIME MANUFACTURERS OF REFRACTORY METALS ENGINEERED FOR THE JOB

T-706

830 Market Street • Waukegan, Illinois

use of a fully automatic, saturable reactor control system. Only two hours are required to reach 5000 F. Gates on both ends of the heated zone reduce radiation losses.

The furnaces can be used for high-temperature research, investigation of high-temperature ceramics and cermets, investigation of hot-pressing techniques for metal oxides, carbides, borides, etc. Bulletin 858 available.

Hevi-Duty Electric Co, 2040 W Wisconsin Ave, Milwaukee 1, Wis

MORE DATA? Circle 72, inside back cover

High-Speed Industrial Counter Incorporates Plug-In Unit

Robot-Eye RE-8 photo-electronic unit counts by interrupted or reflected light beam; there is no physical contact with objects being counted. Model will detect and count at a rate of 1500 per minute objects ¼ in. long moving at 2 fps. The 6-digit plug-in counter reportedly has a life of over 100,000,000 counts. Replacement element simply plugs in.

Device consists of three units: amplifier-counter, photo cell, and light source. Standard light source is 5 in. long; miniature light source, designed for installation in very limited space, is 2¼ in. long. Either is available when unit is purchased. Sensitivity adjustment is provided in amplifier. Supply is 115 v, 60 c, ac. Price is $110.

Standard Instrument Corp, 657 Broadway, New York, NY

MORE DATA? Circle 73, inside back cover

Servo-Controlled C-Press Provides Complete Control of Ram Motion

Servo-controlled C-Press, especially applicable to straightening operations, is reported to give operator complete control of ram speed and travel, distance, and tonnage imposed on work. All press actions are controlled without unnecessary and space-taking linkages.

When the control lever is pushed, spiral cam connected to ram turns fast thread of valve spool actuator. Slow hand motion produces slow ram movement; fast hand motion produces fast ram movement. Bed and throat area is completely unobstructed for tooling and fixtures.

The close ram-motion control makes this press useful in laboratory as well as production work, die try-out work, compacting tests and other applications of a research nature.

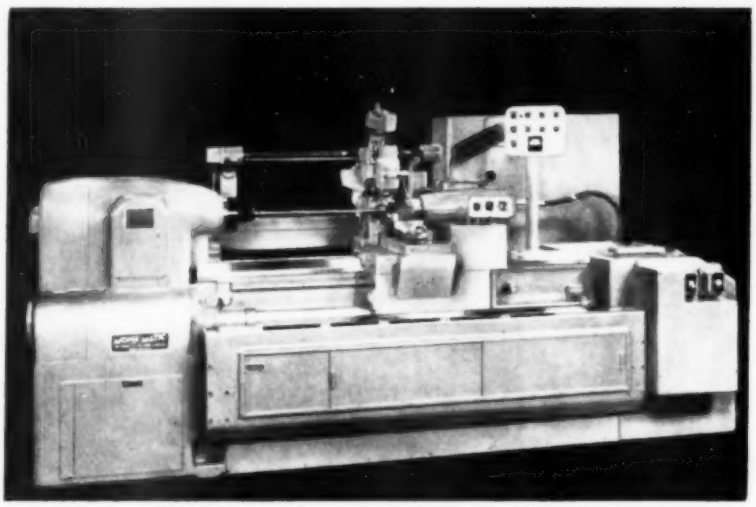
Hydraulic Press Mfg Co, Div of Koehring Co, Mount Gilead, Ohio

MORE DATA? Circle 74, inside back cover

Recessing Tool Can Be Used Without Jigs in Deep Holes

This JS-type recessing tool performs automatic, extremely accurate deep hole recessing operations without a supporting jig. The tool is supported rigidly at the point of work and can be used with a variety of nose-piece extensions to fit the part being machined.

It can machine a multiple of in-



Tracer-Controlled Follow Rest Speeds Turning of Slender, Contoured Work

Long, slender workpieces, especially those that are tubular, are difficult to turn without springing. When contours are to be turned on the OD, conventional steady or follow rests cannot be used. To solve this problem Monarch has developed a tracer-controlled follow rest for its Model 21 Mona-Matic lathe.

The follow rest rollers are mounted above and behind the workpiece. Each roller is moved in and out by its own hydraulic cylinder which is controlled by a separate "air-gage tracer." Another follow rest roller, spring loaded, is located adjacent to and immediately following the tool. Turning is accomplished under "air-gage tracer" control, the tracer slide being set at 90° to the work. The templet, in the form of a master workpiece, is traced by three tracer heads. The front head controls the tool; the other two correspond in position to the follow rollers they control.

Provision is made for the use of two master workpieces when a rough and a finish cut are necessary.

Infinitely adjustable hydraulic feed up to 40 ipm is provided. There is a separate feed rate controller for the rough and finish feed rates which may be adjusted as necessary for the work and tool characteristics. Rifle and shotgun barrels are typical workpieces.

Monarch Machine Tool Co, Sidney, Ohio

MORE DATA? Circle 75, inside back cover

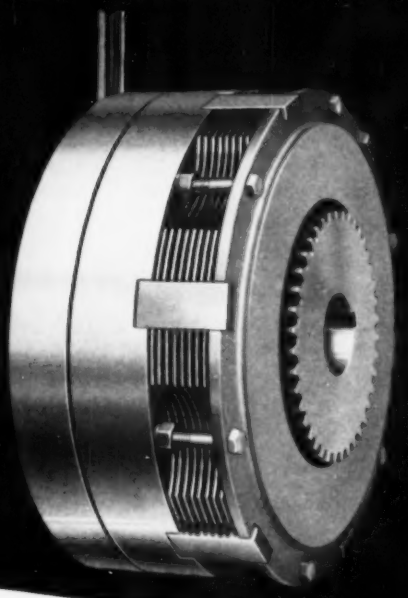
the clutch with the most advantages...

fast cyclic operating rate . . .

large torque capacity in small area . . .

great heat-dissipation capability . . .

high efficiency in wet or dry operation . . .



. . . top performance in all functions: starting, running, torque limiting, cyclic

. . . simple installation

. . . adaptability to automatic controls

. . . get them all with

Fawick SC Magnetics

FAST RESPONSE! — FAWICK Magnetics respond instantly to controls — have provided rates as fast as 40 cycles per second! They respond to limit switches, relays, punched tape or any other electric or electronic control.

LARGE TORQUE CAPACITY — Excellent torque-vs.-size ratio — example, 2100 inch-pounds running torque with a 5½" diameter clutch operating dry!

FAST HEAT DISSIPATION — Exceptional heat dissipation characteristics permit faster cycling under heavier loads over longer periods of time than other clutches of comparable size.

"WET" OR "DRY" OPERATION— FAWICK friction discs are designed for operation either in oil or dry . . . in dry operation they are not harmed by unintentional presence of oil.

SUPERIOR CLUTCH FUNCTION — Consistent performance, cycle after cycle — plus direct relationship between coil voltage and torque capacity — provide extreme accuracy and versatility.

SIMPLE INSTALLATION — FAWICK Magnetics are supplied completely assembled — bores and keyways for clutch body and gear are made to required specifications.

For detailed information write today for bulletin M-102.

FAWICK AIRFLEX DIVISION
FAWICK CORPORATION
9919 CLINTON ROAD • CLEVELAND 11, OHIO
Fawick Canada, Ltd., 60 Front St., West, Toronto, Ont., Canada

FAWICK
MAGNETIC

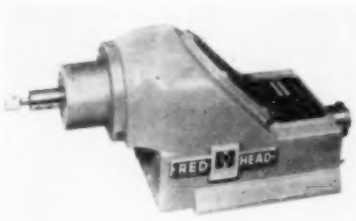
FAWICK MAGNETICS — WORLD'S FINEST ELECTRIC CLUTCHES

CIRCLE 266 READER SERVICE CARD

ternal forms simultaneously and with the use of spacers it can machine a series of forms using only one holder. Its feed ratio is approximately 7.5 to 1.

Maxwell Industries, Inc, 493 East Fifth St, Ashtabula, Ohio

MORE DATA? Circle 76, inside back cover



Belt-Driven Wheelheads Generate Spindle Speeds up to 100,000 rpm

Interchangeable cartridge-type Heald wheelheads develop spindle speeds of 45,000 to 100,000 rpm for grinding small diameter holes where surface speed of the grinding wheel is critical.

The basic belt-driven wheelhead consists of a jackshaft and body unit and the spindle cartridge. Two interchangeable spindle cartridges are available. One operates at speeds of 45,000, 52,000, and 60,000 rpm, the other at 70,000, 85,000, and 100,000 rpm. The wheelheads are built with 4-in. center height as standard.

The Heald Machine Company, 6 New Bond St, Worcester 6, Mass

MORE DATA? Circle 78, inside back cover

process report: Increased surface hardness, equivalent to 70-74C; increased wear resistance; keener cutting tool edges; reduced time in tool setting and grinding; increased production, toughening of soft skin, if any, due to faulty hardening.

A F Holden Co, 14341 Schaefer Hwy, Detroit 27, Mich

MORE DATA? Circle 79, inside back cover

Link-Belt Develops High-Capicity Spherical Roller Bearings

Reported to be the highest capacity spherical roller bearings yet developed, these self-aligning bearings features maximum diameter and quantity of convex rollers for each bearing size; precision machined, centrifugally cast bronze retainers; and high, heavy inner race shoulders.

The bearings are being introduced initially in series 22200 and 22300, in bore sizes from 1.5748 to 11.0236 in. with dynamic load ratings up to 288,000 lb. The bearings will also be available in pillow blocks in bore sizes ranging from 1 7/16 to 10 in.

Link-Belt Co, Prudential Plaza, Chicago 1, Ill

MORE DATA? Circle 77, inside back cover

Surface Hardening Treatment Prolongs Cutting Tool Life

The Hy-Speed Case process makes use of a surface hardening neutral salt bath to impart greater wear resistance and increased surface hardness to high-speed steels and high-carbon, high-chrome alloys after they have been hardened, tempered and ground. Users of the

Lightweight Comparator Accepts Any Dial Indicator

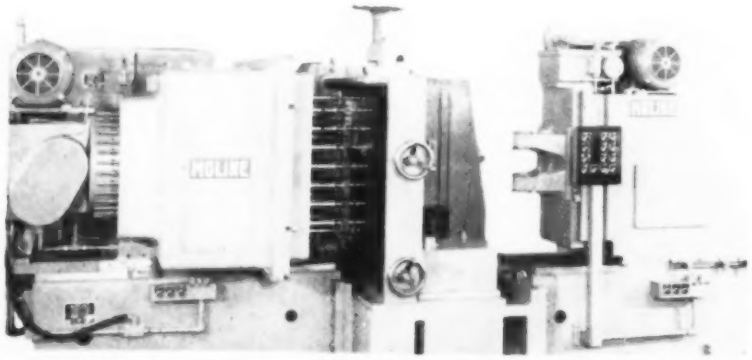
The Model A comparator can be supplied with any of the company's 67 dial indicators. Supplied alone, it can be equipped with an adapter that accommodates any dial indicator with conventional back. As a result, this comparator can be used for an extremely wide range of precision measuring jobs with any AGD dial indicator available.

An aluminum base makes the comparator lighter and easier to handle without reducing its stability and rigidity. Coarse adjustment is made by sliding the indicator up and down the column and clamping in position. Fine adjustment is then made by rotating the left-hand knob in either direction and locking in position with the right-hand knob.

The stage is adjustable and reversible from front to back and, by rotating it 90°, from side to side. The standard Model A is equipped with a $1^{3}/_{4}$-in.-dia column, with $3^{3}/_{8}$ in. of clearance between column and contact point. Vertical capacity above anvil is $3^{5}/_{8}$ in. Other models offer $5^{5}/_{8}$ and $7^{5}/_{8}$-in. vertical capacities.

Petz-Emery, Inc, Pleasant Valley, NY

MORE DATA? Circle 80, inside back cover



TRACTOR TRANSMISSION CASES are drilled and milled on this special Model HHU86 three-way, multiple-spindle machine. The drilling unit at the left has 47 universal-joint-driven, slip-type spindles and the rear horizontal drilling unit, not visible in the photo, has 23 spindles. At the right of the workholding fixture is the two-spindle milling unit—*Moline Tool Co, Moline, Ill*

MORE DATA? Circle 81, inside back cover

IT PAYS TO STANDARDIZE ON **STANSCREW**

Machine Bolts and Carriage Bolts Now Produced to Stanscrew Quality Standards

Stanscrew presents a new line . . . carriage and hex machine bolts . . . now produced and stocked in a complete selection of more than 500 different sizes. Manufactured under careful quality control methods, they meet the same standards of uniformity and dependability which have made other Stanscrew fasteners a leading choice of American industry for over 80 years.

These new additions bring Stanscrew's complete line to over 5,000 different types and sizes of standard, catalogued fasteners. From this comprehensive selection you can find dependable, economical answers to the overwhelming majority of all your fastener needs.

Your Stanscrew fastener specialist, available through your nearby Stanscrew distributor, can show you many ways these inexpensive standard items will cut your product costs . . . for example, by replacing costly special fasteners.

Each of the over 5,000 different Stanscrew fasteners is always kept in stock at three conveniently located plants. This enables your Stanscrew distributor to provide faster service . . . to be particularly helpful in emergency situations where prompt delivery can mean substantial savings.

So, whatever your fastener requirements, just call your nearby Stanscrew distributor. Or for complete information on Stanscrew's new carriage and machine bolts, simply mail the coupon below.

STANSCREW FASTENERS

STANDARD SCREW COMPANY

CHICAGO | THE CHICAGO SCREW COMPANY, BELLWOOD, ILLINOIS

HMS | HARTFORD MACHINE SCREW COMPANY, HARTFORD, CONNECTICUT

WESTERN | THE WESTERN AUTOMATIC MACHINE SCREW COMPANY, ELYRIA, OHIO

Standard Screw Company
2701 Washington Blvd.
Bellwood, Illinois

Please forward complete information on

☐ Machine bolts ☐ Carriage bolts

Name _____ Title _____

Company _____

Address _____

City _____ State _____

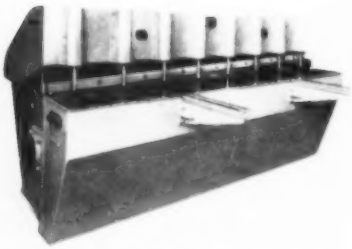
CIRCLE 267 READER SERVICE CARD

High Spiral Fluted Tap Reduces Breakage in Ductile Materials

Designed to perform with outstanding results in ductile materials such as aluminum, copper, and mild steel, this Turbo-Cut tap incorporates a relatively high spiral flute to provide maximum chip removal and reduce tap breakage without sacrificing accuracy. It also provides excellent results in stainless steel and plastics.

Threadwell Tap & Die Co, Greenfield, Mass

MORE DATA? Circle 82, inside back cover



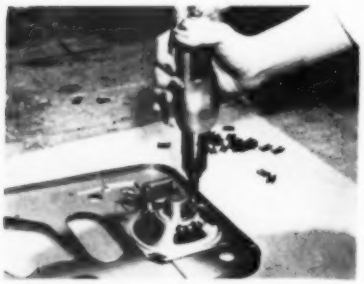
German Guillotine Shears Feature Long Knife Life

Imperial-Wieger guillotine shears (German), equipped with swinging knife guidance, are reported to have a rubbing friction of only 3% contrasted with 50% rubbing friction formerly found on parallel knives. Shears also feature back gage, spring-loaded hold-downs, and single-stroke control.

Cutter blades have two cutting edges for quick changing when one edge becomes blunt. Shears are said to cut even the narrowest strips without twist.

Distributed by Aaron Machinery Co, Inc, 45 Crosby St, New York 12, NY

MORE DATA? Circle 83, inside back cover



Lightweight Air Hammer Speeds Fastener Attachment

Model SP-900B attaches push-on fasteners, such as Pal-Nuts, or Speed-Nuts, in 1/3 the time taken by ordinary hand methods, according to manufacturer.

Unit weighs 20 oz, uses 6.5 cfm at 90 psi, is equipped with metering trigger for complete operator control, and is available with pistol grip or straight handle. Price is $52.50.

Superior Pneumatic & Mfg, Inc, 4758 Warner Rd, Cleveland 25, Ohio

MORE DATA? Circle 84, inside back cover

Vibration Speeds Separation of Abrasive Media and Tumbled Parts

A vibratory unit built into this separator provides more effective screening and separation of barrel-finished parts and abrasive media. Completely shock mounted, the vibrator imparts high-frequency, low-amplitude vibrations to the screening mechanisms.

A larger bed, with a screening surface 18 in. wide and 48 in. long, does a more effective separating job with a wider range of parts and media sizes and shapes. The separator comes equipped with three screens to handle most of the standard operations, but can be readily adapted to handle all standard screen mesh sizes.

Roto-Finish Co, 3700 Milham Rd, Kalamazoo, Mich

MORE DATA? Circle 85, inside back cover

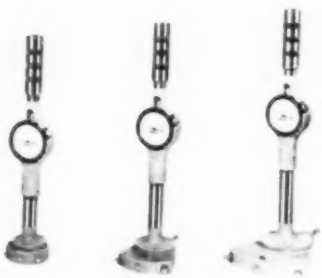
3-Flute HSS End Mills Have Fast Spiral and High Rake Angle

Tools are designed for milling aluminum and aluminum alloys. Flutes are hollow ground and highly polished. Design makes for rapid stock removal and ends are relieved to eliminate excessive chip loading. At full cutting depth, two flutes are always in the cut.

The new tool series is available in 3-flute single end regular length, long length, and extra long length in square end and ball end. Total of 76 tool sizes are listed.

Melin Tool Co, 3351 W 140th St, Cleveland 11, Ohio

MORE DATA? Circle 86, inside back cover



Dial Bore Gages Measure, Inspect Cylindrical Bores

No. 84 Series, designed for inspection as well as checking hole sizes during machining or grinding oper-

(Continued on page 160)

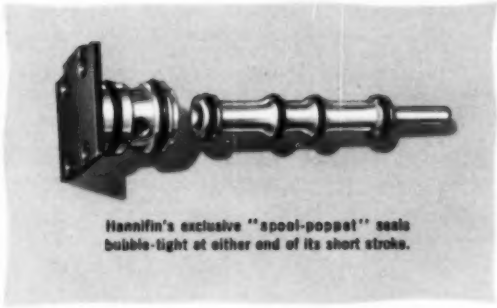
From HANNIFIN...

unit construction

to give you air valves

that do more jobs

Hannifin ⅜" four-way valve with "universal" base and new Speed Control section. Single-solenoid actuated, 10 other actuators available.



Hannifin's exclusive "spool-poppet" seals bubble-tight at either end of its short stroke.

For complete J.I.C. compliance, valve is electrically inoperative until dust-tight, splashproof solenoid cover is replaced and fastened tightly. Result: no more clogged, jammed solenoids.

One of the versatile – and most popular – Hannifin air control valves is this "CC" series, single-solenoid model. It is available for either ¼" or ⅜" air lines and is gasket-mounted to its own base. This particular base (one of three choices offered) can either be O-ring gasketed to your manifold or mounted over an opening in your bracket or machine. It will receive all four lines from below or take the inlet line from below and the two cylinder lines out one side. Or, you can make all connections at the sides.

When it comes to actuation, Hannifin offers an even wider selection: hand, foot, cam, pressure, single or double solenoid.

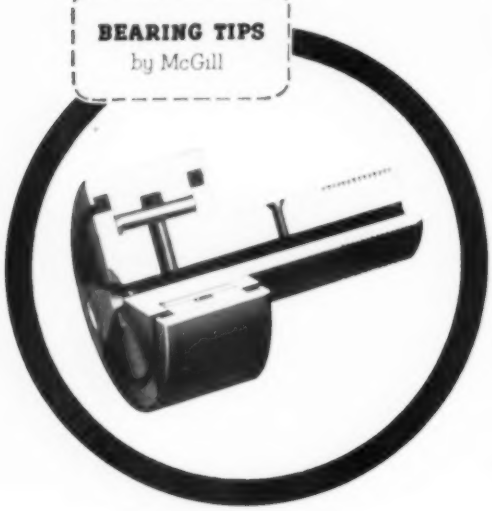
When necessary, you can remove this entire valve from its base without disconnecting air lines. Or, the exclusive "spool-poppet" can be replaced without even breaking electrical connections.

The "CC" series, like all Hannifin valves, is designed with "full flow" internal passages as large or larger than its rated pipe size.

You will find these and most other Hannifin valves described in Hannifin's new "Valve Finder." Get your copy from your Hannifin man, listed in the A-Z volume of Thomas' Register, or write:

HANNIFIN COMPANY
525 South Wolf Road • Des Plaines, Illinois

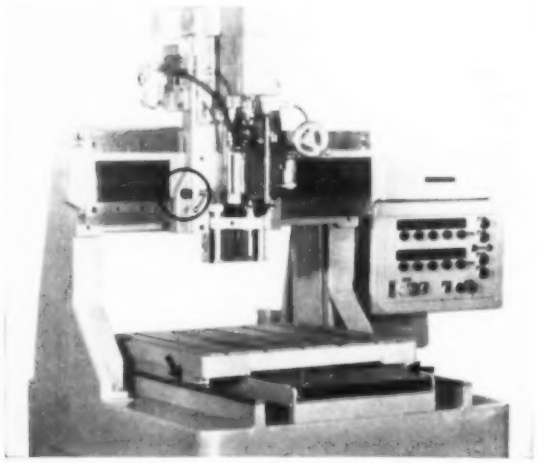
BEARING TIPS
by McGill



McGILL sealed *CAMROL* bearings protect roller follower efficiency — prelubricated to reduce maintenance

Sealed SCF series bearings add protection from contamination to the extra performance advantages of McGill CAMROL cam followers. Specially treated labyrinth seals at the roller ends keep out moisture, dirt, chips, etc. All exposed surfaces are treated to provide a corrosion resistant black ferrous oxide finish.

The sealed construction with a channeled grease reservoir in the outer race bore eliminates need for frequent relubrication. Maintenance is reduced and can be eliminated in inaccessible mountings. Specify standard bearings and avoid building up followers with extra seals.



Sealed CAMROL bearings as table and crosshead rollers in tape-controlled Hillyer drilling machine

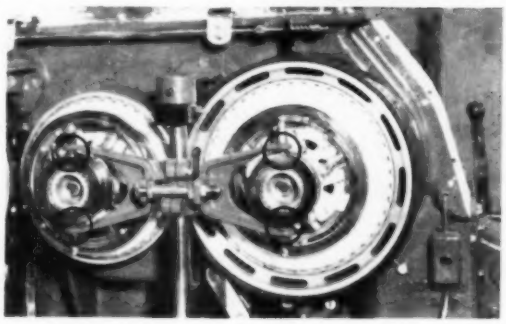
CAMROL bearings provide smooth, accurate motion as load carrying rollers for table and crosshead motion of this tape-controlled, precision drilling machine manufactured by HILLYER CORPORATION. Use of these bearings has simplified construction and improved accuracy. They have eliminated the manufacture of shaft and retainer assemblies and increased load capacities. The corrosion resistant finish has also eliminated the need for plating bearings. Ball bearings formerly used cracked under the same loads. Operating speeds are 400 RPM and loads are 2000 pounds. The bearings are prelubricated and sealed to keep maintenance at a minimum.

Sealed CAMROL bearings replace bronze rings in shovel clutches

UNIT CRANE & SHOVEL CORPORATION is using SCF SEALED CAMROL bearings in clutch shifter yokes in their ½ and ¼ yard power cranes and shovels and Model 360 MARINER 30-ton cranes. Shown is a closeup of two of the five clutches which control the hoist drum and the hold drum and various actions of the machines. The bronze collars formerly used were higher in initial cost than the CAMROL bearings. Their use also required considerable machining and the addition of component parts such as bolts, spacers, etc.

The CAMROL bearings in this application promise better, more accurate control than the bronze shifter rings which tend to become "sloppy" with wear.

The integral seal feature of the bearings protects their performance under field conditions and reduces relubrication requirements.



engineered electrical products

McGILL

precision needle roller bearings

SEND FOR CATALOG No. 52-A

MULTIROL — GUIDEROL — CAMROL

McGILL MANUFACTURING COMPANY, INC., BEARING DIV., 300 N. LAFAYETTE ST., VALPARAISO, INDIANA

Why Business Prefers Ohio

OHIO RATES second only to California in the affections of a number of the nation's key industrialists. However, the music from this second fiddle is melodious to the ears of Ohioans. It emanates from the industrial world—the hum of assembly lines, the whir of propellors of newly produced planes, the thumping of pneumatic stamping machines and many other notes familiar in areas of economic progress.

At the moment Ohio is second in the thoughts of industrial leaders when they are queried on their preferences of states in which to locate new plants. And it is a close second.

In a poll taken among 283 industrial officials, 61 favored Ohio as the area their companies would consider in picking a new plant site. Only California, with 77 votes, outdid the Buckeye State.

THE POLL which gave Ohio its 61 first choice votes was taken by Business Week magazine, Executives were asked to state the major factors or reasons that enter into the decision of considering a new plant location.

By far the most important reason uncovered by the survey was nearness to market, sales area or customers. Other leading considerations were available labor supply, reasonable taxes, availability of raw materials, transportation or shipping facilities, weather or climate and labor costs.

Ohio has much to offer in these categories. Its good inventory in these necessities to industry has enabled it to advance tremendously in recent years. At present Ohio is second only to New York as the nation's No. 1 industrial state.

NO ONE CAN QUESTION the excellent geographical location of Ohio. Its transportation facilities—rail, air and truck—are among the best. An already abundant supply of highly skilled labor is constantly mounting. Tax conditions in Ohio are favorable to industry and weather is pleasant even though it fluctuates from below zero to above the 100 mark.

From the results of Business Week's poll and the great industrial growth Ohio is experiencing, the day must surely come when Ohio is the No. 1 industrial state in the nation.

NEARNESS TO MARKETS: You can easily reach *the people you buy from* and *the people you sell to* when your business or industry is located in Ohio . . . center of the nation's richest markets.

AVAILABLE LABOR SUPPLY: Ohio plants draw on a large, highly-skilled labor pool. Ohio leads in a broadened program of technical education.

REASONABLE TAXES: Ohio business taxes are lower than in many industrial states. Ohio's state and local governments welcome new industry and help it succeed.

ABUNDANT RAW MATERIALS & UTILITY SERVICES: Ohio plants profit from ready access to water, coal, iron ore, steel, natural gas, electricity, rubber, chemicals, atomic energy.

GOOD TRANSPORTATION: Modern rail, air and trucking facilities serve every section of Ohio. Low-cost water transportation links Ohio with 32 states and all overseas markets.

***FOR DETAILED INFORMATION** on available industrial sites or any aspect of plant location in Ohio, write or phone Division of Economic Development and Publicity, Ohio Dept. of Commerce, Columbus 15, Ohio.*

(Editorial published in *Ohio State Journal*, Columbus, Ohio, December 13, 1958).

If you're looking to the future . . . locate in OHIO

ations, will measure bore diameter in ten-thousandths or half-thousandths, and will indicate variations from true bore such as taper, out-of-round, bell mouth, hour glass, or barrel shape.

Furnished in three sizes to cover a range of 3 to 12⅛ in., they are available in six models to provide a choice of indicator readings in 0.0001 or 0.0005 in.

L S Starrett Co, Athol, Mass

MORE DATA? Circle 87, inside back cover

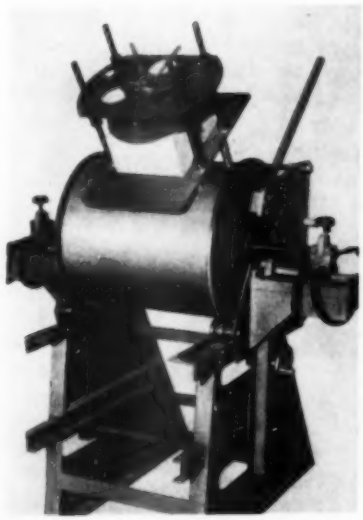
Granite Surface Plates Added To Pratt & Whitney Gage Line

New granite products range from small toolmakers' flats to large 7 x 14-ft surface plates, and include accessory items such as granite layout, angle and T-slotted plates, parallels, and straight edges. Surface plate stands with either leveling screws or casters are also available.

A certificate of inspection is furnished with each plate, guaranteeing its overall autocollimator accuracy and plotting the deviation from a true plane in millionths of an inch for each position inspected.

Pratt & Whitney Co, West Hartford 1, Conn

MORE DATA? Circle 88, inside back cover



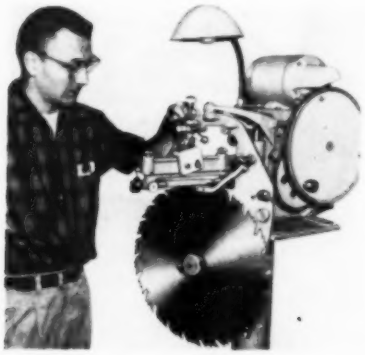
Indirect Arc Furnace Features Mold-Clamping Attachment

This barrel-type, 60-lb-capacity, indirect arc furnace features a dump-over arrangement with a mold-clamping attachment that permits a Shaw Process or investment mold to be clamped directly over the pouring hole. Riding on ball-bearing rollers, the furnace barrel, with mold attached, can be inverted 180°.

Furnace, designated 60-Z Mark II, features the company's Zirconal composite crucible. By removing the mold attachment the furnace can be used for lip pouring into a ladle or mold.

British Machine and Foundry Supplies Ltd, Div of British Industries Corp, Port Washington, NY

MORE DATA? Circle 89, inside back cover



Automatic Saw Filer Sharpens Combination Circular Saws

Model 200 Foley automatic saw filer is reported by the manufacturer to be the first machine which will file combination (rip and crosscut) circular saws. It will also file crosscut circular saws, band saws, and all types of hand saws.

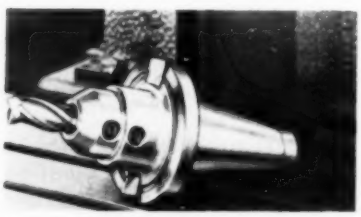
The filer is fed an entire segment of the combination circular saw and files each tooth all the way around the saw before proceeding to the next tooth.

Foley Mfg Co, Dept 200, Minneapolis 18, Minn

MORE DATA? Circle 90, inside back cover

DIE CASTINGS FOR CONTROL VALVES are drilled, reamed, formed, chamfered, spotfaced, and tapped at a gross rate of 480 parts per hr on this 11-unit special machine. A 26-in.-dia index table holds eight work fixtures with manual clamping and unclamping. Eight of the twelve tools are combination tools; all tools except the taps are guided by bushings—*Kingsbury Machine Tool Corp, Keene, NH*

MORE DATA? Circle 91, inside back cover



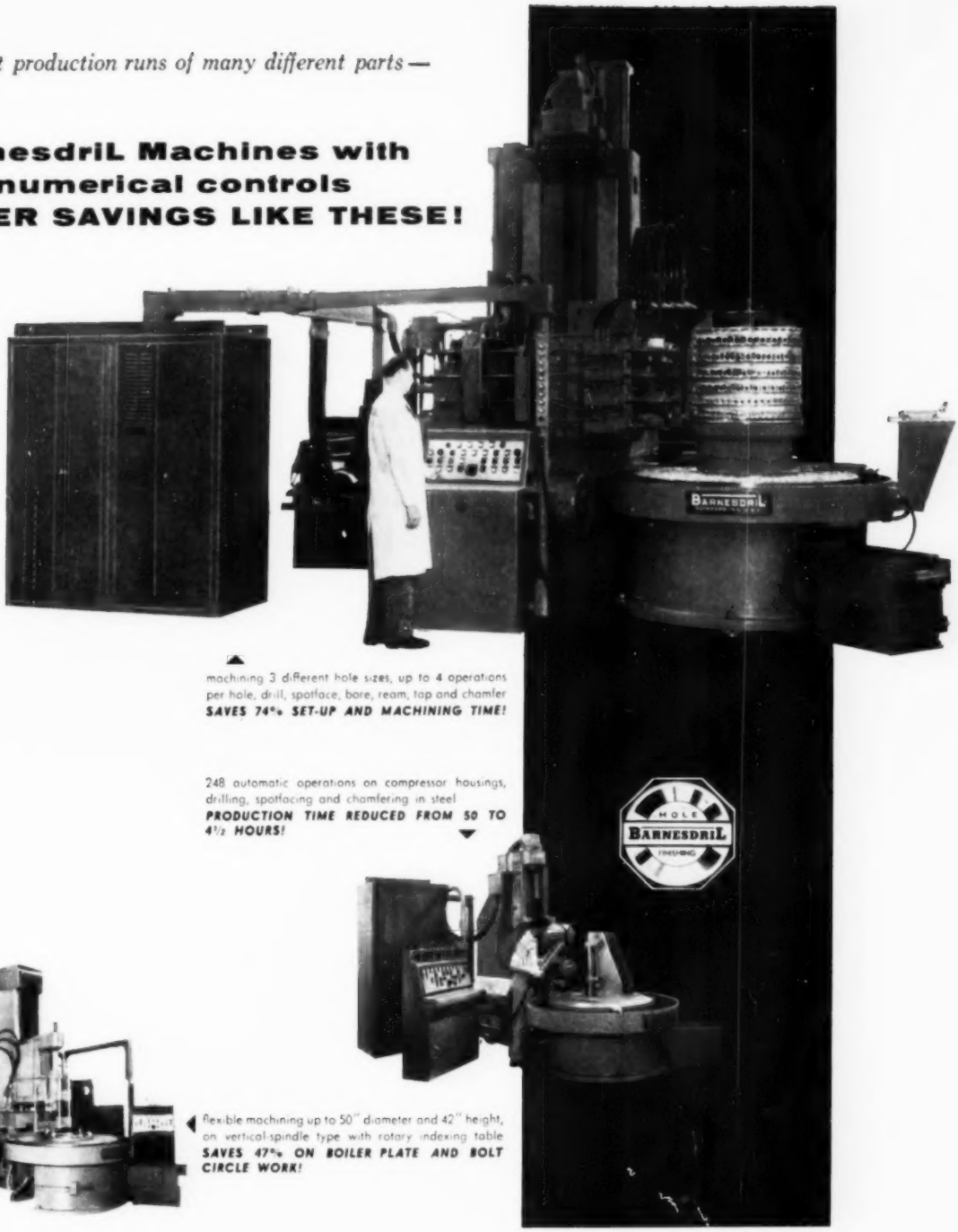
New End Mill Holders Speed Tool Changing

Holders for use in all horizontal and vertical milling machines with No. 50 NS taper spindles having Cincinnati Arbor-Loc feature are now being carried as stock items.

They serve double or single-end

for short production runs of many different parts —

BarnesdriL Machines with G-E numerical controls OFFER SAVINGS LIKE THESE!



machining 3 different hole sizes, up to 4 operations per hole, drill, spotface, bore, ream, tap and chamfer
SAVES 74% SET-UP AND MACHINING TIME!

248 automatic operations on compressor housings, drilling, spotfacing and chamfering in steel
PRODUCTION TIME REDUCED FROM 50 TO 4½ HOURS!

flexible machining up to 50" diameter and 42" height, on vertical-spindle type with rotary indexing table
SAVES 47% ON BOILER PLATE AND BOLT CIRCLE WORK!

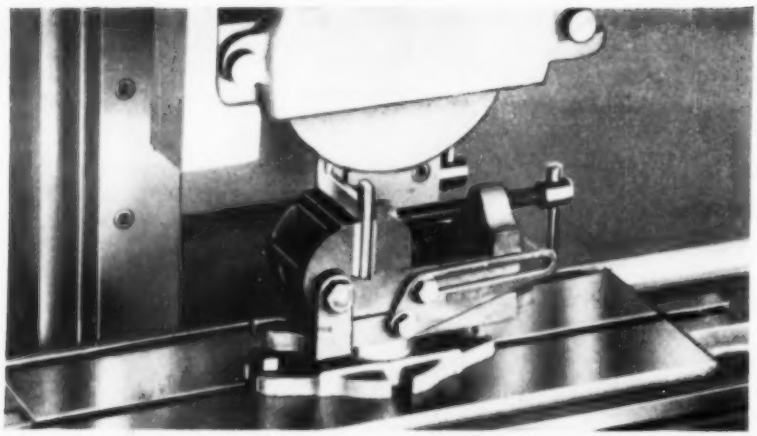
Flexible automation reduces costs where short production runs of different parts are required. For comparison of your costs, write for full details on these machines.

FLEXIBLE AUTOMATION

BARNES DRILL CO.

830 CHESTNUT STREET • ROCKFORD, ILLINOIS
DETROIT OFFICE: 13121 Puritan Avenue

ORIGINATORS OF PRODUCTION HONING AND AUTOMATIC COOLANT CLEANING

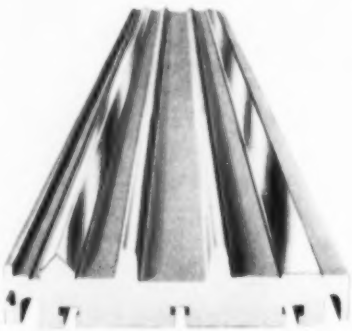


This is not an ordinary surface grinder at work...

It's a Covel No. 10—built to do MICRO-PRECISION work on accurate snap gages like this. And it also does a top-notch grinding job on other tool room work such as form tools, jigs and dies—day after day and year after year to save you money. Covel pioneered with *hard chrome table ways* that keep this 6" x 18" machine in *top position* in the tool room grinder line-up far longer than grinders with ordinary ways. Covel-developed smooth *timing belt table drive*, hardened and ground lead screws and rigid vertical slide are among other outstanding features that add up to long-lived Covel MICRO-PRECISION performance.

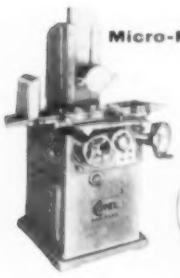
First with hard chrome table ways...

A special plating process developed by Covel applies a hard chrome surface to hand-scraped Vee and flat table ways—insuring long-lived accuracy. Many Covel chrome plated ways have been in service for ten years and more without noticeable wear and without a sign of flaking.



Ruggedly built... hand or power feed models available

The No. 10, like all Covel Precision Grinders, depends on a heavy, well-ribbed and proportioned base and wheel head standard as a foundation for built-in MICRO-PRECISION. Both hand and power feed models have all hand wheels, including elevating hand wheel, conveniently located *below* table level.



Micro-Precision a Covel Tradition-Since 1874

Send today for your copy of "The Covel Precision Story" and complete data on the Covel Surface Grinder that meets your needs — seven sizes from 6" x 12" to 16" x 36". Ask for Bulletin AM-59

COVEL PRECISION GRINDERS

BENTON HARBOR, MICHIGAN

mills with shanks from ⅜ to 1¼ in. inclusive. Changing the holder is a simple operation, yet it grips the end mill securely.

Weldon Tool Co, 3000 Woodhill Rd, Cleveland, Ohio

MORE DATA? Circle 92, inside back cover

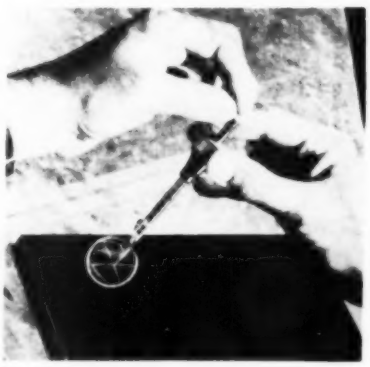
Differential Air Control Offered in New Model

Air control for use with company's diaphragm chucks and air-operated Tork-Lok arbors is designed to increase or decrease clamping pressure during the machining cycle to control distortion.

Two pre-selected pressures are used—one adjustable pressure to operate the air device, for loading; the other to regulate the amount of air released when clamping the part. Difference between the two pressures is the true pressure applied to the work.

N A Woodworth Co, 1300 E Nine Mile Rd, Detroit 20, Mich

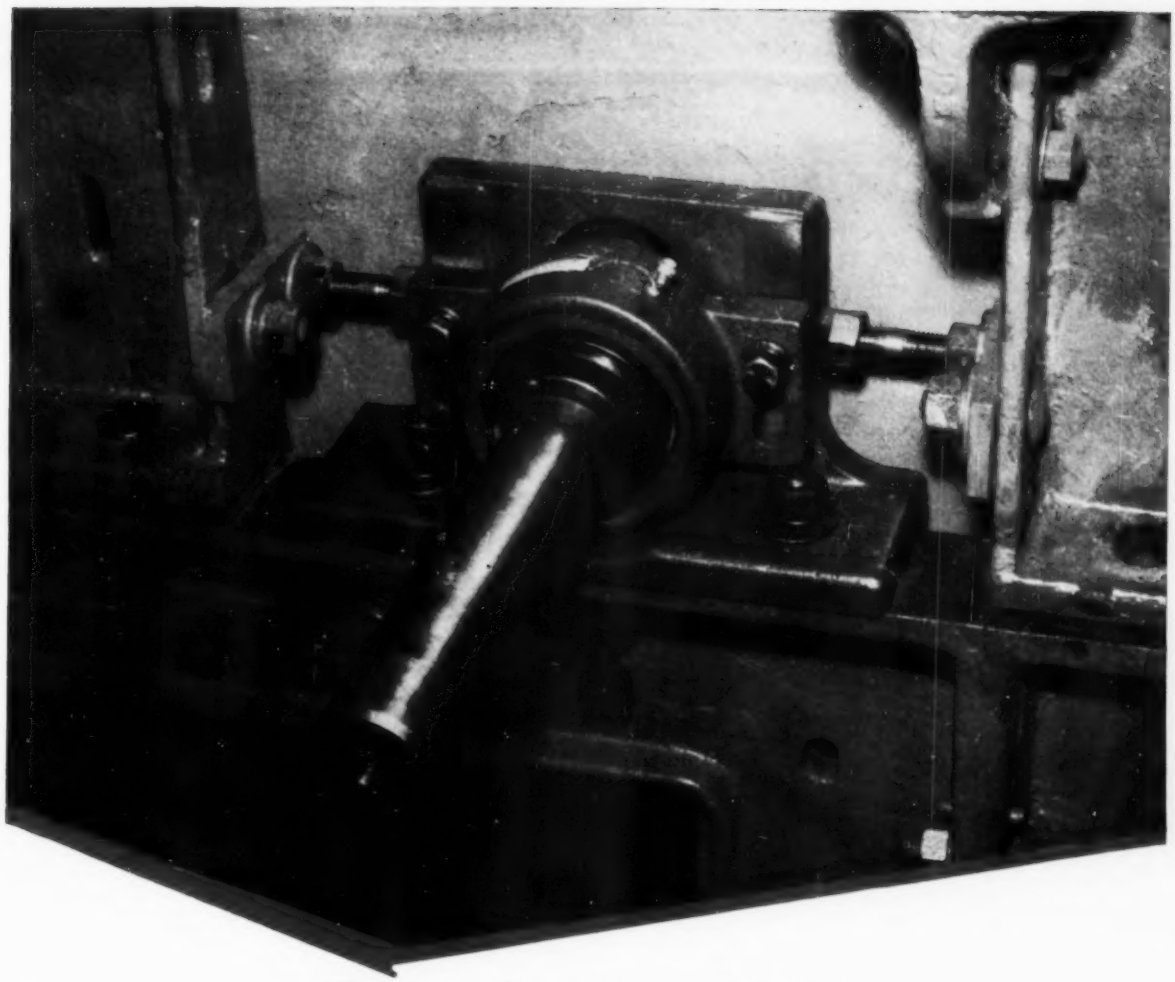
MORE DATA? Circle 93, inside back cover



Tool Combines Center Punch, Hammer, Magnifier, Scriber

Centa-Scribe, a combination center punch, hammer, magnifier, and scriber, is a precision hand tool for ma-

(Continued on page 166)



Bearings, Inc.

designs and supplies anti-friction bearing conversion units for many applications

This sliding, take-up unit is installed on textile mill equipment. It illustrates one of many clean, practical fixtures our bearing engineers have designed to hold the bearings best suited to carry shafts with a minimum of maintenance and with low power consumption. Our customer is pleased with the success of this installation in cutting operating costs, improving quality and increasing production.

Your request for a Bearings, Inc. engineer to survey your machinery and recommend anti-friction bearing conversions where practical, will be promptly answered. It's a service we're glad to perform at no cost to you.

Call the Bearings, Inc. branch nearest you NOW!

Providing bearing service in the North ➤ **BEARINGS, INC.**

OHIO: Akron • Canton • Cincinnati • Cleveland • Columbus • Dayton • Elyria • Hamilton • Lima • Lockland • Mansfield • Toledo • Youngstown • Zanesville
INDIANA: Ft. Wayne • Indianapolis • Muncie • Terre Haute • **PENNSYLVANIA:** Erie • Johnstown • Philadelphia • Pittsburgh • York
WEST VIRGINIA: Charleston • Huntington • Parkersburg • Wheeling • **NEW JERSEY:** Camden
NEW YORK: Buffalo, Balanrol Corp. • **MARYLAND:** Baltimore • **DELAWARE:** Wilmington

and in the South ➤ **DIXIE BEARINGS, INC.**

FLORIDA: Jacksonville • **GEORGIA:** Atlanta • **KENTUCKY:** Louisville • **LOUISIANA:** Baton Rouge • New Orleans
N. CAROLINA: Charlotte • Greensboro • **S. CAROLINA:** Greenville • **TENNESSEE:** Chattanooga • Kingsport • Knoxville • Nashville

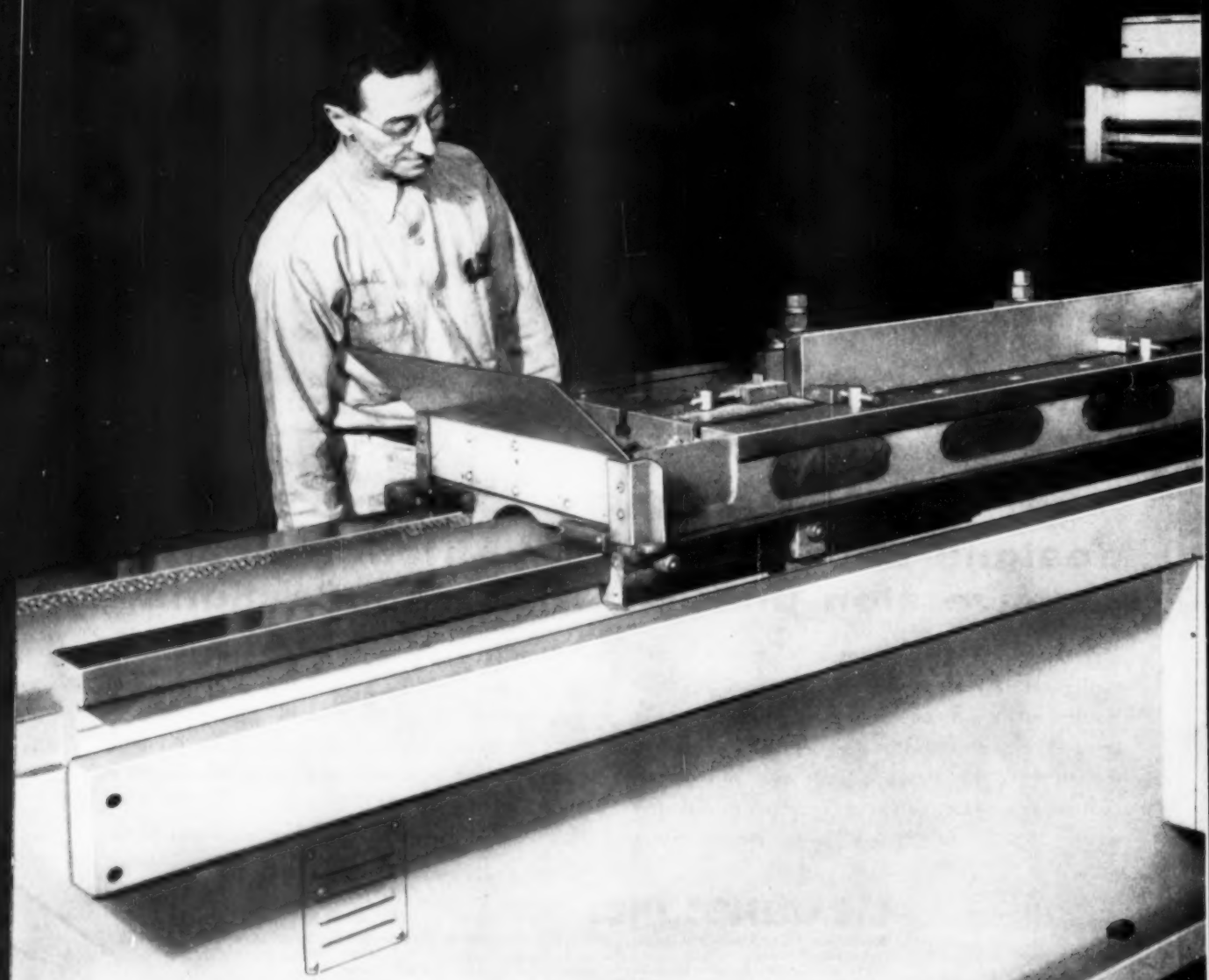
Ball & Jewell, Inc.

INCREASE PRODUCTION, CUT COSTS!

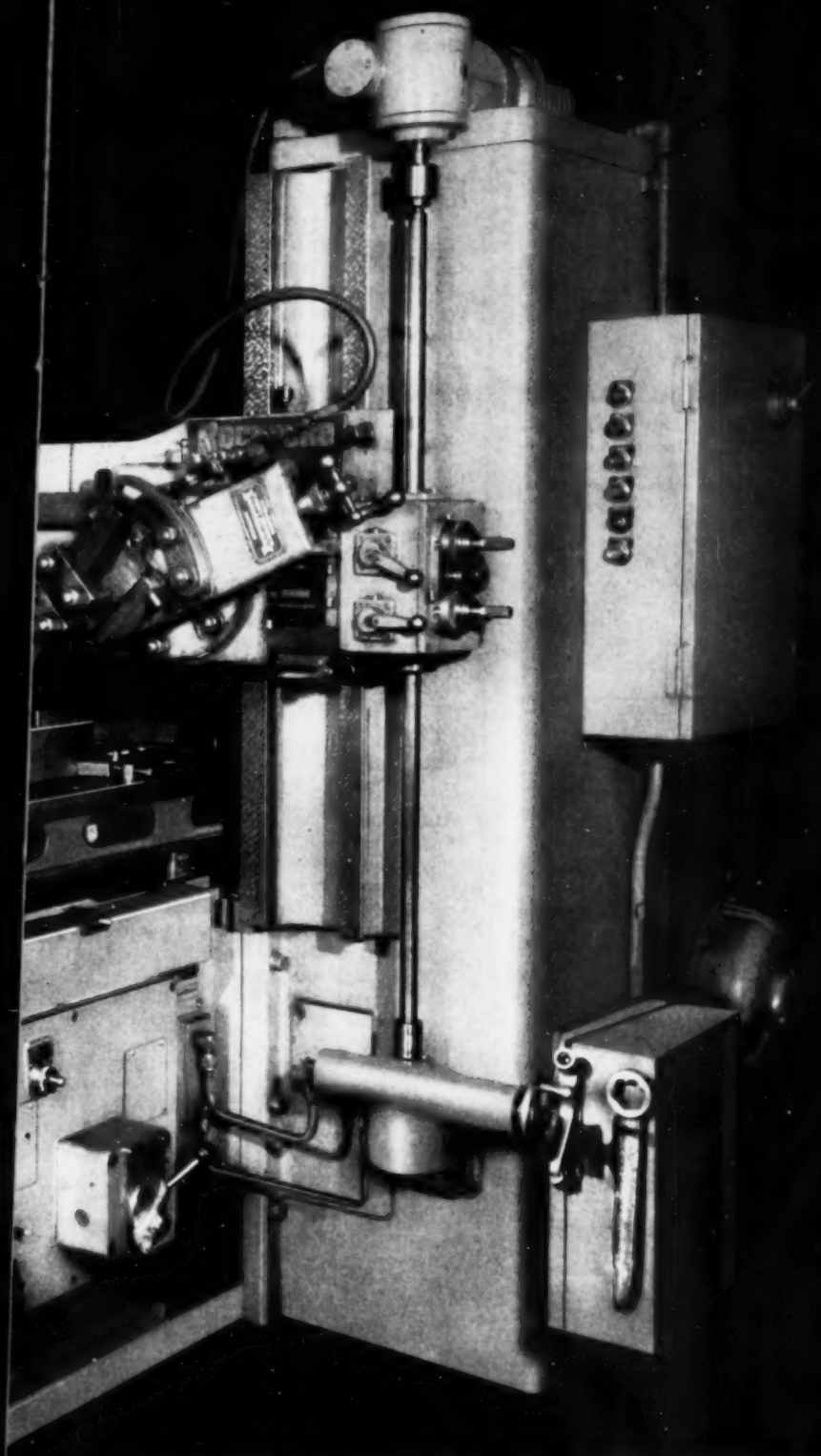
using Rockford Hy-Draulic

OPENSIDE SHAPERS

Eliminate Costly Fixtures and Multiple Operations by Shaping Cutter Blades Quickly In Continuous Bar-Form.



HY-DR



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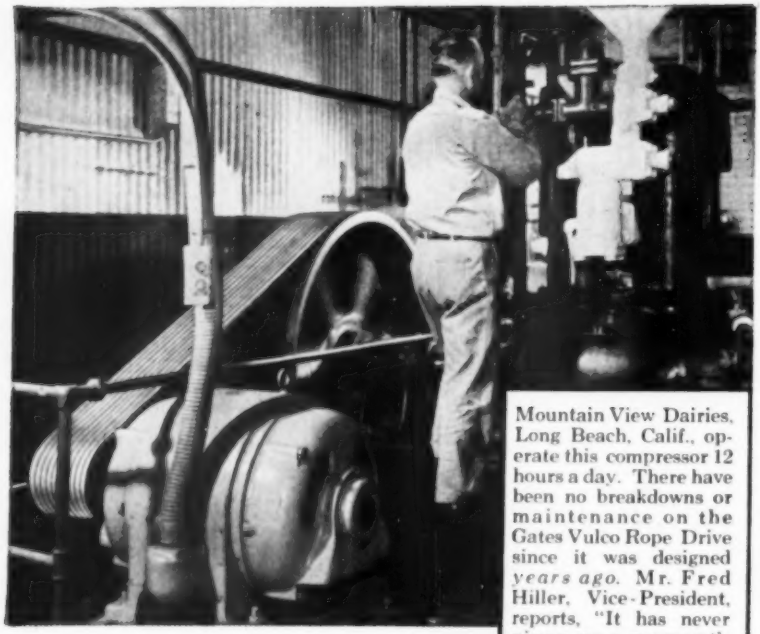
HYDRAULIC

ROCKFORD MACHINE TOOL CO. 2500 KISHWAUKEE STREET ROCKFORD, ILLINOIS

AUTO

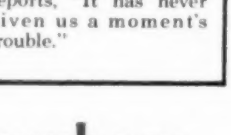


Mountain View Dairies, Long Beach, Calif., operate this compressor 12 hours a day. There have been no breakdowns or maintenance on the Gates Vulco Rope Drive since it was designed *years ago.* Mr. Fred Hiller, Vice-President, reports, "It has never given us a moment's trouble."

The No. 1 choice of industry everywhere

...the V-belt with concave sides

To prove to yourself why concave sides give this V-belt far longer life, make this simple test: bend a Gates V-Belt as if it were going around a sheave. Feel how the concave sides (Fig. 1) *fill out* ... become perfectly straight (Fig. 1-A).



Note how the belt makes full contact with the sides of a sheave ... grips evenly, thus distributing wear uniformly along the sides of the belt. Uniform wear lengthens belt life — keeps costs down.

With a straight-sided belt (Fig. 2) the sides *bulge out* when the belt is bent, and wear is concentrated on the bulge (Fig. 2-A). Uneven wear shortens belt life — increases belt costs.

Because Gates V-Belts with concave sides are so universally preferred, they are the *most widely available.* There are Gates Distributor stocks in industrial centers *throughout the world.*

The Gates Rubber Company, Denver, Colorado

Gates Rubber of Canada Ltd., Brantford, Ontario

World's Largest Maker of V-Belts TPA 392

Gates Vulco Rope Drives

chinists, templet makers, designers, engineers, loftsmen, layout men, tool and die makers, and maintenance men.

For rapid center punching, the tool is assembled with the hammer raised, and, after locating the center, the hammer is dropped from the top of the handle. A carbide point scriber is also available.

Langley Corp, 310 Euclid Ave, San Diego, Calif

MORE DATA? Circle 94, inside back cover

Anodizing rack system consists of a rigid titanium spline plus disk-shape titanium workholders fitted with integral clamps. Workholders can be quickly and positively positioned at any desired location on the spline. Degree of adjustment is continuous from one one-thousandth of an inch to 32 in. Unlimited variety of parts can be racked on the available disk types.

Service Screw Products Co, Anodizing Rack Div, 133A North Green St, Chicago 7, Ill

MORE DATA? Circle 95, inside back cover

Aluminum etch cleaner, improved Etchalume 14, is a powdered material which is added to water and can be operated over a wide range of concentrations and temperatures depending upon the degree of etching desired. It is said to produce a fine, uniform etch and leave the surface of aluminum clean and free from any residual, slimy film of aluminum hydroxide.

Enthone Inc, New Haven, Conn

MORE DATA? Circle 96, inside back cover

"Ever notice how J. C. Keeps his head when all about are losing theirs?"

Why the Big Swing to Gun-Drilling ?

Because BOREMATION

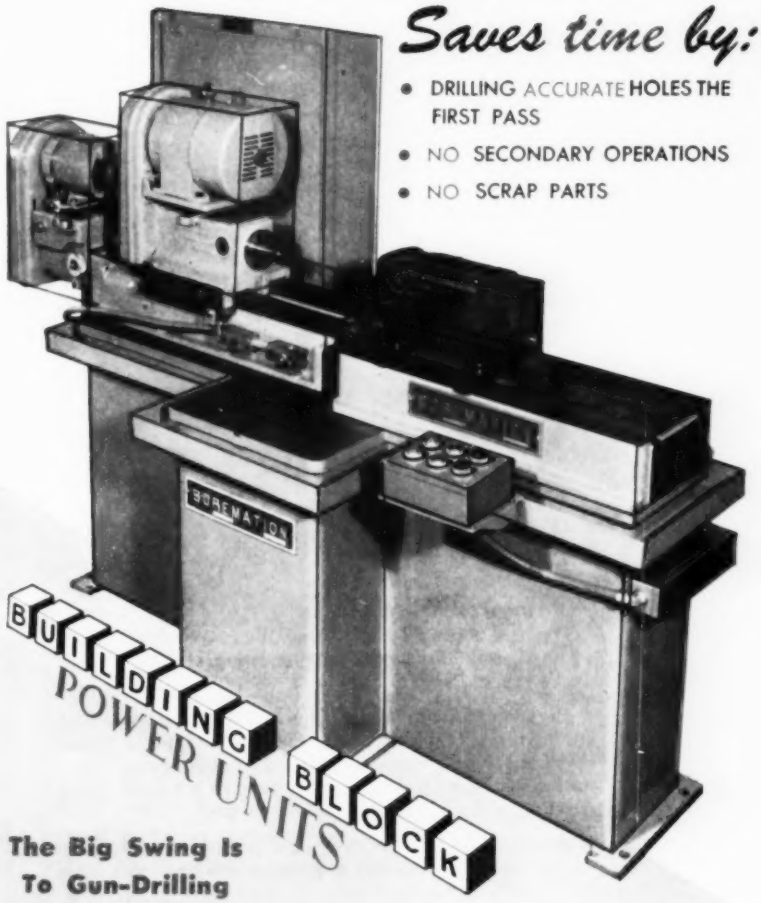
GUN-BORING AND DRILLING

A constant High Pressure supply of coolant can be directed to the cutting edge of the tool by any one of our five High Pressure, High Velocity, "Building Block" Coolant Units.

Metal particles as small as 5 microns are eliminated by the "dual" BOREMATION filtration system built into the ccolant units.

Saves time by:

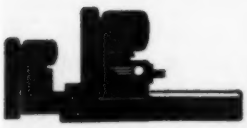
- DRILLING ACCURATE HOLES THE FIRST PASS
- NO SECONDARY OPERATIONS
- NO SCRAP PARTS



5 standard way type **MODELS**

Model 1200
12" Stroke Hydraulic Feed

Model 1200-M
12" Stroke Mechanical Feed



Model 2400
24" Stroke Hydraulic Feed

Model 2400-M
24" Stroke Mechanical Feed

Model 3600
36" Stroke "Servo-System"

Up to 60" stroke available

The Big Swing Is To Gun-Drilling

Did you know that "Gun-Drilling" is the only successful method of deep-hole drilling or boring which can still maintain True Alignment with Close Tolerances and a High Grade Finish with one pass?

BOREMATION Gun-Boring and Drilling will cut your operating costs by eliminating secondary operations and costly scrap.

Sound impossible? Just check the multitude of necessary and extra features built into a standard BOREMATION Power Unit, and, you too will be convinced.

You too can be assured of accuracy that will save you: parts, time and money, when you switch to Gun-Boring or Drilling with a BOREMATION Power Unit.

DRILLMATION CO. INC.

6500 E. ELEVEN MILE RD.

CENTERLINE, MICH. JEfferson 9-2030

BUILT TO J.I.C. AND N.M.T.B. STANDARDS

AVAILABLE WITH FROM ONE TO SIX OR MORE GRINDING HEADS

CAPACITIES:

6" x 96" Belt:
5½" max. width and
6½" max. thickness

9" x 96" Belt:
8½" max. width and
6½" max. thickness

12" x 96" Belt:
11½" max. width and
6½" max. thickness

OPTIONAL FEATURES:

Electro-Magnetic chucks
Powered elevation of grinding heads
Built-in coolant filtration system

From the leaders in the industry . . .

The new Series 96 Heavy Duty abrasive belt machines are built to deliver toolroom precision in continuous production runs.

High speed multiple grinding and finishing operations are performed in the same time required for a single operation. Rapid, exceptionally heavy stock removal permits unmachined surfaces to be ground to fine finishes and exacting tolerances in one continuous pass.

Heavier construction and solid, one-piece work table enable Series 96 machines to maintain tolerance standards of ± .0005 on flat finishing, with stock removal up to 1/32" per head on ferrous material.

Conveyorized feed is adjustable, ranging from 0' to 67' per minute. Both conveyor and abrasive belts feature pneumatic tensioning.

Rapid-traverse grinding heads are equipped with #50-taper hardened precision ground spindles, with super-precision taper roller bearings.

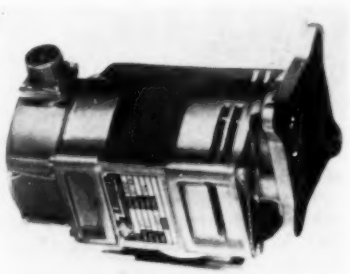
Representing the peak of development in abrasive belt machines, Series 96 take their place beside the finest of machine tools for speed, precision, reliability and cost reduction.

Write today for free catalog sheet containing complete information and specifications on the Engelberg Series 96 abrasive belt machines.

ENGELBERG, INC.

Precision **ABRASIVE BELT GRINDERS**

188 SENECA STREET • SYRACUSE, N. Y.



Direct Current 2-v Motor Delivers 2.0 hp at 3000 rpm

Model D-820 is of open frame construction. Foot mounting can be changed to accomodate end or pad mounting. Other output shafts are available for keyed, splined, or flats. Higher output speeds are available by removing the reduction gear box.

Applications include hydraulic pump drives, pneumatic compressor drives, and fuel pump drives. It can also be used to operate fork lift trucks and industrial handling equipment.

Hoover Electric Co, Hangar Two, Port Columbus Airport, Columbus 19, Ohio

MORE DATA? Circle 97, inside back cover

Diamond dressing tools are available from stock in all types and styles including single point, faceset, edgeset, layerset, lineset, sliverset, sidemount, and thread grinding dressers. Specials can be produced to specifications in 3-5 days.

Edco Tool Co, 93 Oak St, Wyandotte, Mich

MORE DATA? Circle 98, inside back cover

Lubseals that protect grease fittings during spray painting are available in standard carton (1000, four colors). Seals color-code all fittings and protect against particles of grit and abrasives from collecting and being injected into the bearing. Price per carton, $7.50.

Wilson Plastics, Inc, 1531 Milan Rd, Sandusky, Ohio

MORE DATA? Circle 99, inside back cover

Tool storage unit, Model 181, has 78 compartments for storage of drills, reamers, taps, etc. Two top shelves have 15 compartments, each 2-3/16 in. wide; its two center shelves have 13 compartments 2-9/16 in. wide, and two bottom shelves have 11

compartments each 3 in. wide. Unit can be used alone or will fit into standard shelving arrangements. It is 33¼ in. wide, 16½ in. deep, and 34⅝ in. high.

Alan Wood Steel Co, Penco Div, 200 Brower Ave, Oaks, Penna

MORE DATA? Circle 100, inside back cover

Stainless steel rings and disks can be secured machine-cut to size with tolerances close enough and edges smooth enough for many applications without further processing. Size accuracy is normally held within ±1/32 in. although cutting can be done to much closer tolerances when required. If other machine work has to be performed to make them into finished components, such as drilled holes, or surface finishing, this can also be done before shipment.

Joseph T Ryerson & Son, Inc, Box 8000-A, Chicago 80, Ill

MORE DATA? Circle 101, inside back cover

Vernier magnifier is made of clear plastic. Two permanent alnico magnets are embedded in the base for attaching to metal scales. Price is $2.50.

Bausch & Lomb Optical Co, Rochester 2, NY

MORE DATA? Circle 102, inside back cover

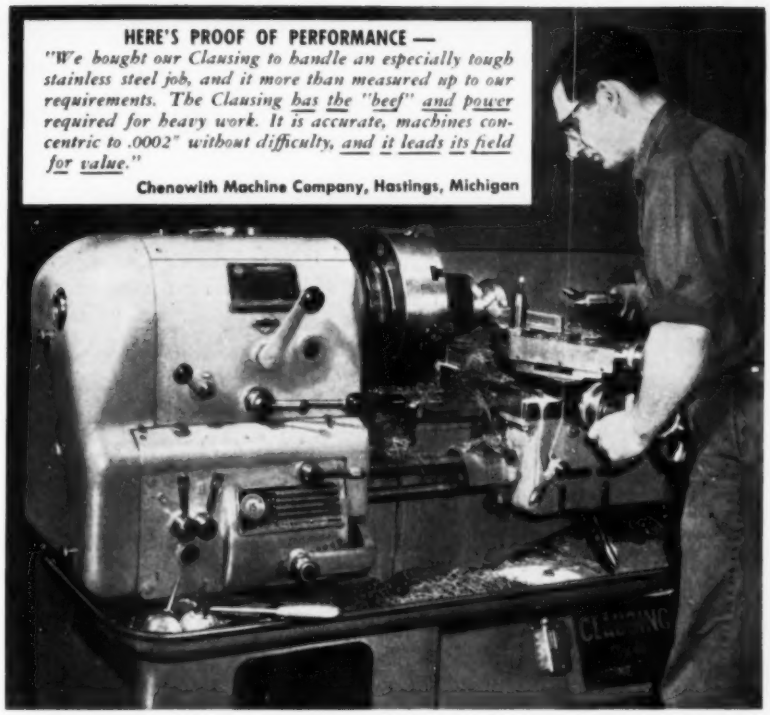
Deep-drawn aluminum machining stock is now available in sizes up to 4 in. in diameter. The deep drawing creates the most desirable grain

"You can't help but admire his work—If you don't he'll paste you one!"

HERE'S PROOF OF PERFORMANCE —

"We bought our Clausing to handle an especially tough stainless steel job, and it more than measured up to our requirements. The Clausing has the "beef" and power required for heavy work. It is accurate, machines concentric to .0002" without difficulty, and it leads its field for value."

Chenowith Machine Company, Hastings, Michigan



Performance records PROVE

CLAUSING COLCHESTER LATHES

Superior Construction ... Greater Value

Clausing geared-head lathes do lead their field in capacity, performance and value. Here's why:

They're bigger in capacity than other lathes in their class. Larger spindles, larger thru-hole capacity, larger bearings for heavier work. 17" lathe spindle, for example, has 3 1/16" thru hole – 15" lathe, 2 1/16" hole – 13", 1 9/16" hole.

Have heavy-duty construction. Massively built throughout. Bed ways are induction hardened. Gears in head and quick-change box run in bath of oil. Power feeds are taken from separate feed rod, lead screw is used for thread cutting only. Spindles are high-tensile steel.

Built for precision performance – to American standards of toolroom lathe accuracy. Have Gamet Micron tapered roller bearings with oil flow lubrication – the most advanced and accurate bearings known to industry.

Each is an outstanding value. 13" cabinet base models, including motor and controls, start at $2113; 15" cabinet base at $2988; 17" at $4715. You owe it to yourself to investigate before investing in *any* lathe.

Lathe Capacities: 17" lathe: 54" and 78" centers, 28" swing in gap; 15" lathe: 30" and 48" centers, 24" swing in gap; 13" lathe: 24" and 36" centers, 18" swing in gap.

CLAUSING DIVISION *Write for Free Literature*
ATLAS PRESS COMPANY
3-101 N. Pitcher St. • Kalamazoo, Michigan

CIRCLE 279 READER SERVICE CARD

Unless you buy leaded steels directly from Inland's Indiana Harbor Works, chances are you've never seen this tag. But among Cold Drawers and Steel Warehouse men who process and sell leaded steels in a variety of forms to manufacturers, it is famous.

Every one of them recognize that behind this tag lies years of research, development and *unequaled experience.* Twenty years ago it marked the world's first commercial leaded steel. Today this tag represents the standard of performance by which all other free-machining steels are compared. It signifies LEDLOY* . . . the most machinable leaded steels obtainable.

INLAND STEEL CO., 30 West Monroe Street, Chicago 3, Illinois.

Get Inland Ledloy *steels in cold drawn form, sometimes sold under different trade names, from leading cold drawers and Steel Service Centers from coast to coast.*

*Reg. Trade Mark

This is

INLAND

LEDLOY®

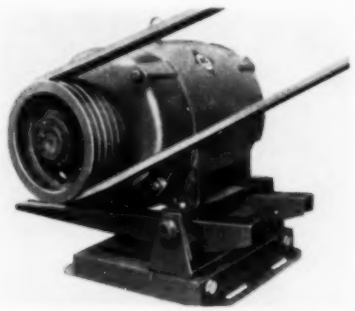
WORLD'S MOST MACHINABLE STEEL

INLAND STEEL COMPANY

structure for efficient machining. New sizes are available in all popular aluminum machining alloys and tempers, including 2011, 2014, 2017, 2024, 6061 and 6066.

Harvey Aluminum, 19200 S Western Ave, Torrance, Calif

MORE DATA? Circle 103, inside back cover



Reaction-Torque Motor Base Takes All NEMA Sizes Through Frame 505

Reaction torque tilting motor base for automatic belted drive tension control under changing load conditions is being offered by A-C.

Available in bases to take all NEMA sizes through frame 505 as well as for special applications requiring larger frames, the new base makes possible more efficient use of space because of its compact design. Reactive torque is directly proportional to the horsepower; belt tension increases and decreases as the load varies.

Allis-Chalmers Mfg Co, Milwaukee 1, Wis

MORE DATA? Circle 104, inside back cover

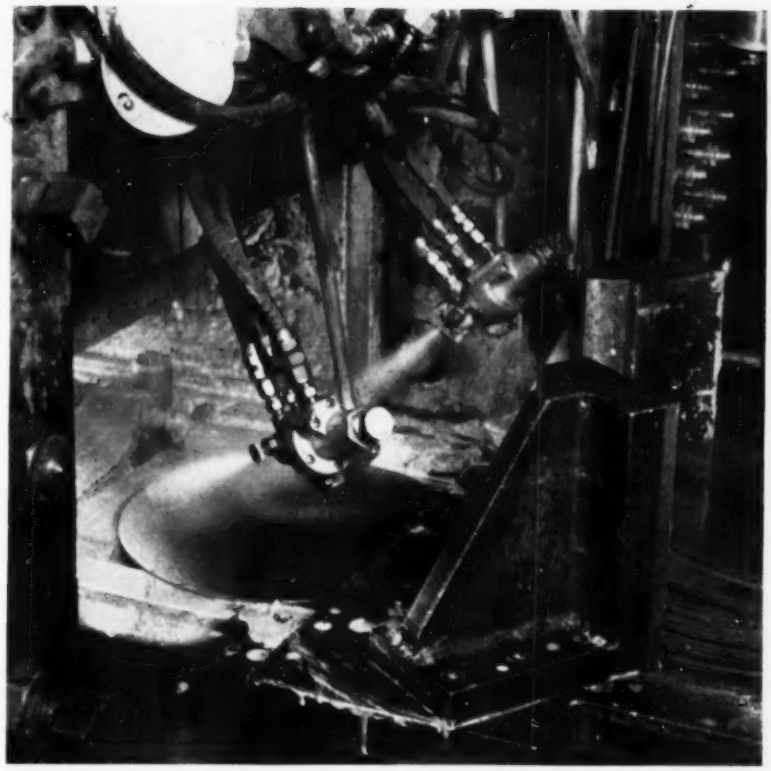
Capscrew and nut line, called Bowmalloy, has a proven tensile strength of 186,820 psi. Capscrew's new head design is 20% higher than SAE specifications, matches the increased strength of the bolt and eliminates head damage caused by wrench slippage.

Bowman Products Co, Cleveland, Ohio

MORE DATA? Circle 105, inside back cover

Gas-air burners, Multiport P-R line, for localized heating operations, combine positive flame stability with maximum heat release and low turndown. Wide operating ranges of the burners with any commercial fuel gas permit effective use for applica-

(Continued on page 174)



SPRAY LUBRICATION SPEEDS PRESS-ROOM PRODUCTION

. . . saves material, protects dies, reduces rejects

By comparison, any methods of lubricating dies other than spray are haphazard and inefficient. Versatile DeVilbiss WDB automatic guns, that handle all types of compounds, eliminate the waste of manual methods . . . have actually cut die-lube costs as much as 50% in many stamping and forming operations.

By applying a measured amount of lubricant exactly where it's needed . . . *automatically* . . . the DeVilbiss system frees men for productive work, slashes press-maintenance costs, literally eliminates scrap caused by improper lubrications. Compound is delivered from a pressure tank, through hose, in a closed system.

If your manufacturing process involves the application of compounds, lubricants, adhesives, paints, or coatings it will pay you to investigate DeVilbiss automatic spray. Call our nearest representative for full details, or write us direct.

THE DEVILBISS COMPANY
TOLEDO 1, OHIO
Barrie, Ontario • London, England • São Paulo, Brazil
BRANCH OFFICES IN PRINCIPAL CITIES

FOR BETTER SERVICE, BUY
DEVILBISS

CIRCLE 281 READER SERVICE CARD

How to cut costs with the RIGHT motor

Don't be baffled by power factors, torques, efficiencies, and starting, accelerating, and thermal characteristics, or housing, horsepower and speed control. Let Century Electric help you balance these factors to cut operating costs with the *right* motor.

Here's how Century Electric can help you:

10,000 choices—Century Electric engineers can help you specify the right motor without having to rely on a few types to do all jobs. Century Electric makes a complete variety of integral horsepower motors. Over 10,000 types up to 400 hp. There is one for every type of equipment—transfer machines, ball mill drives, compressors, drilling machines, lathes, etc. For all operating conditions too—dusty, corrosive, explosive or moist.

Long life motors—And you get years of dependable operation from Century Electric motors. They are manufactured to rigid quality standards. Electrical tests and other checks on operating characteristics made during manufacture assure you the best motor for your money.

Application know-how—Every Century Electric sales engineer knows motor drive systems because he sells motors and nothing but motors. Often he can give you on-the-spot answers. If not, he can turn to an engineering staff that comes up with quick answers.

You can get the right motor for your equipment just by contacting your nearest Century Electric Sales Office or Authorized Distributor. A Century Electric sales engineer will be glad to help you.

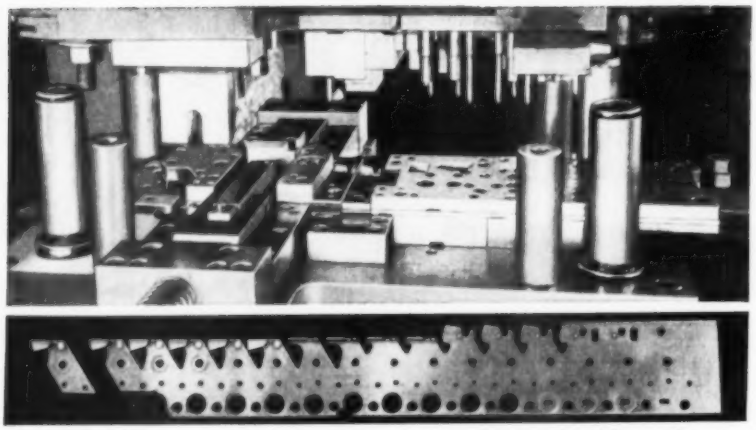
CENTURY ELECTRIC COMPANY

St. Louis 3, Missouri *Offices and Stock Points in Principal Cities*

Century

58-22

CIRCLE 283 READER SERVICE CARD



9 Station Progressive Die and ribbon showing can opener blade ready for assembly as it comes from die. Production: 70 pieces per minute.

HOW B. Jahn PROGRESSIVE DIES MAKE

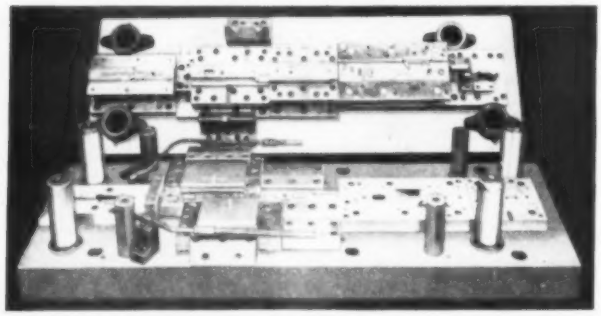
CAN OPENER COMPONENTS BY THE MILLIONS!

Components for can openers are mass produced—high production—close tolerances. Expense for down time can't be tolerated. Production methods must be flawless to protect profits.

That's why this successful can opener manufacturer left the **die design** and **production** responsibilities to B. Jahn.

You too can eliminate production operations, conserve raw material, save valuable hours, improve profits with B. Jahn Dies.

6 Station Progressive Die produces 2 completed can opener handles, right and left, at each press stroke. Production: 140 pieces per minute.



B. Jahn

Send for B. Jahn Brochure Today —

THE B. JAHN MANUFACTURING COMPANY, NEW BRITAIN, CONNECTICUT

tions such as high-temp alloy brazing; glass fire-polishing and forming; heat-treating materials; heating solder pots; silver soldering; liquid heating.

Selas Corp of America, Dresher, Penna

MORE DATA? Circle 106, inside back cover

Adjustable tool and workholding tray for drillpresses is 12 in. in dia and $^3/_4$ in. deep. It is attached to the post by an adjustable clamp which may be raised or lowered. Unit holds small workpieces, oil cans, drills, and miscellaneous tools.

B & I Mfg Co, Burlington, Wis

MORE DATA? Circle 107, inside back cover

Weighing attachment, 5000-lb capacity, is available on the 3000, 4000, and 5000-lb Clarklift models. Controls for the device, including weight indicator, are mounted on the truck steering column; weighing mechanism is mounted between upright and fork plate. Accuracy of weight measurement is not affected by position of load, even when load is carried on one fork.

Clark Equipment Co, Industrial Truck Div, Battle Creek, Mich

MORE DATA? Circle 108, inside back cover

Multi-purpose files, tradenamed Criss-Cross Multi-Kut, incorporate double-diagonal chipbreaker grooves. This design, with its vari-length teeth and criss-cross grooves, is reported to rough-to-size and smooth-to-finish with fewer strokes, with less pressure on tough, dense metals, and with less loading on softer metals. Files are available in flat, half-round, and square shapes, in 8, 10, 12 and 14-in. sizes.

Heller Tool Co, Newcomerstown, Ohio

MORE DATA? Circle 109, inside back cover

Air-hydraulic drilling unit, self-contained Versa-Matic, has a stroke up to 4 in. with $^1/_2$-in. drill. A 90° mounting bracket is available for use on specially designed equipment, as well as mounting bracket to fit most drillpress columns.

General Fire Extinguisher Corp, General Tool Div, 8740 Washington Blvd, Culver City, Calif

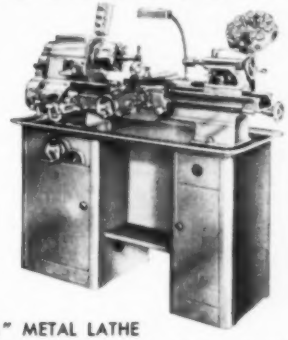
MORE DATA? Circle 110, inside back cover

7" GRINDER
Also 6" Tool Grinder, 6" Bench Grinder

14" METAL-WOOD BAND SAW
Also 14" and 20" Wood

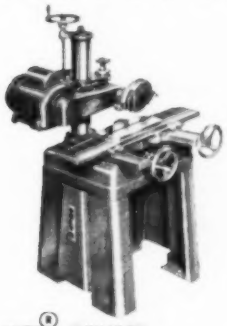
17" DRILL PRESS

6" ABRASIVE BELT FINISHING MACHINE
Also 12" Disc, 2½" Belt Grinder

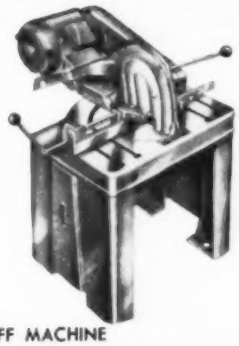


11" METAL LATHE
4' and 5' Bed, also Hand Screw Machine

15" DRILL PRESS
Also 14" and 14" Super-Hi Sensitive



TOOLMAKER® GRINDER
Surface, Chipbreaker, Tool and Cutter



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Wet & Dry Abrasive, Non-Ferrous & Wood

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a proved way to cut metalworking costs

You can match the tool to your job for bigger savings—supplement or replace expensive, special-purpose machines—when you choose from the world's most *complete* line—53 Delta machines, 246 models, over 1300 accessories. Delta tools cost less to buy, less to operate, and less to maintain. They offer precision performance to meet exacting requirements even under rugged, production-line use.

And because you can combine standard Delta components with automatic control devices, you can have the money-saving advantages of automation at a fraction of the usual cost. Ask your Delta Dealer about Delta "lo-cost automation"—and see the complete Delta line of tools and accessories—he's listed under "TOOLS" in the Yellow Pages.

FREE—Delta Industrial Catalog

Get all the facts on the complete line of Delta metalworking and woodworking tools and accessories. Write: Rockwell Manufacturing Co., Delta Power Tool Division, 618C N. Lexington Ave., Pittsburgh 8, Pa.

DELTA INDUSTRIAL TOOLS
another fine product by
ROCKWELL

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INCREASES CENTERLESS GRINDING PRODUCTION

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300%

With This New Automatic Infeed Grinding Attachment

Utmost precision in grinding and duplicate sizing. Sizing dial is graduated in (.00001) one hundredth of a thousandth of an inch. No hydraulic checking cylinder to change feed rate when oil is cold. No checking of oil level or refilling of hydraulic checking cylinder. Three (3) different feed rates are available in one unit for the fastest, most efficient, and precise sizing in a centerless grinder.

CAN BE USED FOR TRU-FEED AS WELL AS INFEED for close sizing. Ideally located push button control station consists of Stop-Button, Caution Pilot Light, and a selector switch for set up or auto grinding positions. **CATALOG** — Write for it today!

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Subsidiary of

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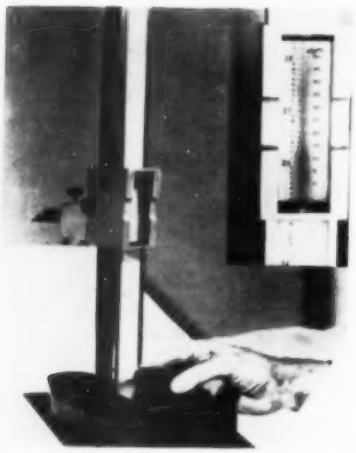


Vernier Height Gage Features Easily Read Scale and Vernier

Employing a glass scale and glass vernier scales which are read from the rear of the gage, the Tumico Optic Vernier height gage provides easy-to-read measurements without the use of magnifiers and auxiliary lights. An inwardly curved chrome reflector behind the glass scale diffuses light and shows the graduations and numbers in sharp relief, with no possibility of parallax errors.

The double-length vernier is 2.450 in. long and is adjustable. A single pushbutton frees the sliding head for approximate setting. Fine adjustment is through a knob on the base. Gages are available in sizes from 18 in. to 84 in. Prices start at $310.

Distributed by George Scherr Co, Inc, 200 Lafayette St, New York 12, NY

MORE DATA? Circle 111, inside back cover

Low-carbon flat stock, with a 35 mu-in. finish, may be case hardened to 1/32 in. by submergence in carburizing salt. Manufacturer claims saving up to 60% in cost over oil hardening stock. Applicable to a variety of jig, fixture, tool, gage and part-making jobs, the stock is 24 in. long, ranges from 1/16-in. to 2⅞-in. thick, and is up to 16 in. wide.

Brown and Sharpe Mfg Co, Providence 1, Rhode Island

MORE DATA? Circle 112, inside back cover

Volatizing flux, called Vapo-Flux, permits brazing in hydrogen or dissociated ammonia atmospheres such materials as A 286, 17-7-PH, Inconel X, GMR 235, and Udimet 500. It is recommended for use with aircraft assemblies such as honeycomb sandwich structures for high-temperature service, heat exchangers and similar applications requiring 1800 to 2000 F brazing temperature range.

Stainless Processing Div of Wall Colmonoy Corp, 19345 John R St, Detroit 3, Mich

MORE DATA? Circle 113, inside back cover

Safety glasses, with a universal bridge, will fit over 95% of employees without requiring adjustment. The Model 2200 glasses have lenses made of S7 square shape clear or green heat-treated glass and CR39 plastic, in.46-mm and 48-mm eye sizes.

Welsh Mfg Co, 33 Magnolia St, Providence 9, RI

MORE DATA? Circle 114, inside back cover

High speed flexible shaft is said by the manufacturer to transmit power at speeds two to three times the maximum recommended for the standard ball-bearing flexible shaft. The rubber-covered shaft comes in three sizes: Model 40HSP with a ⅜-in. core for speeds up to 6900 rpm; Model 50HSP, ½-in. core, 6900 rpm; Model 63HSP, ⅝-in. core, 5750 rpm.

Stow Mfg Co, 29 Shear St, Binghamton, NY

MORE DATA? Circle 115, inside back cover

Insulated metal rivets, named Insulets, have many new sizes previously unavailable and also are now priced lower in production quantities. The nylon insulated rivets are used primarily in electrical applications where it is necessary to fasten metal parts without connecting them electrically. They can also be used to rivet ceramic or glass where the nylon sheath acts as a shock absorber.

Pylon Co, Inc, Attleboro, Mass

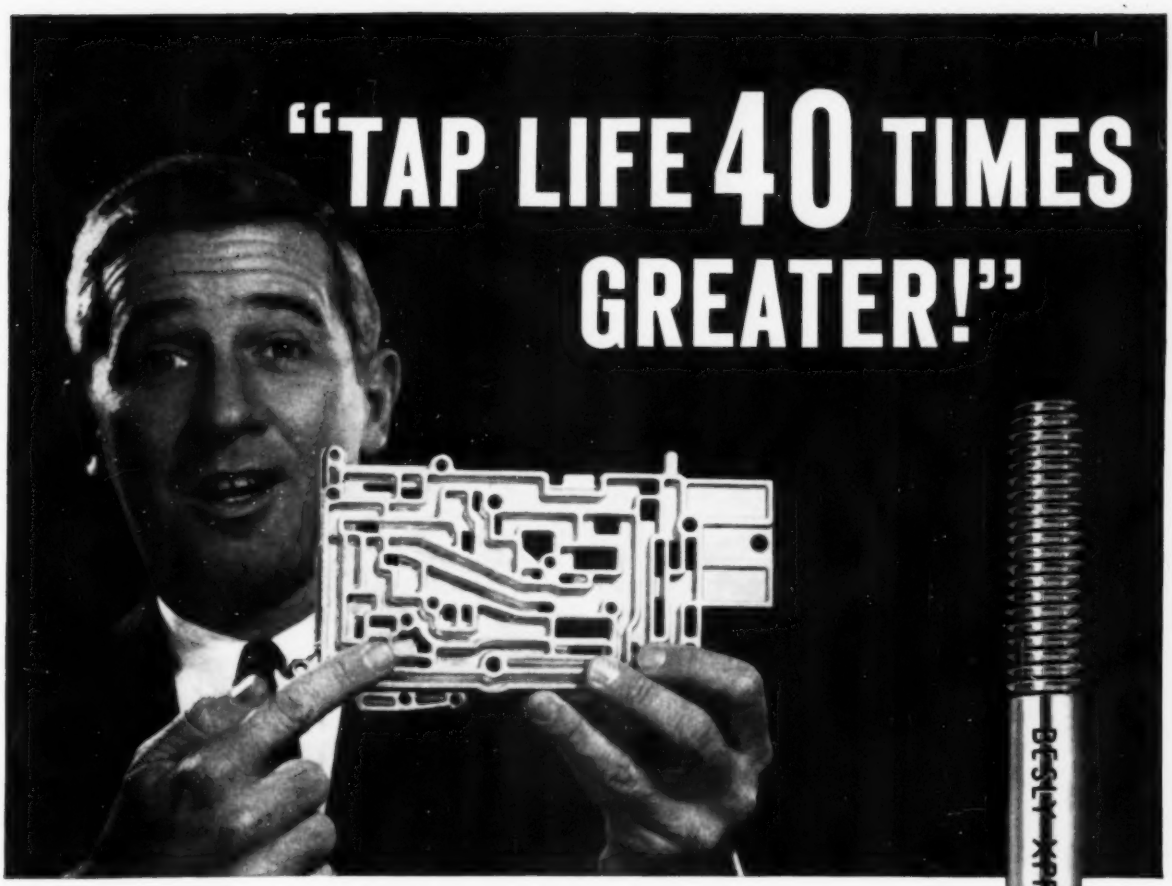
MORE DATA? Circle 116, inside back cover

Non-shrinking grout, named Emeri-Grout, is said to anchor machinery and structural members more securely than was previously possible. Using Cortland emery, a form of corundum, as aggregate, the grouting material has stood up under compression loads of 11,000 psi and will absorb vibration of special machinery without breaking down.

Walter Maguire Co, Inc, 60 E 42nd St, NY 17, NY

MORE DATA? Circle 117, inside back cover

"TAP LIFE 40 TIMES GREATER!"



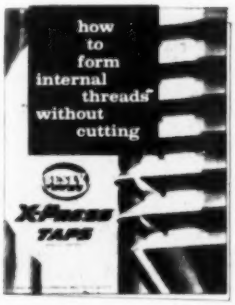
BESLY X-PRESS® TAPS—based on a new cold-forming principle—help boost production and cut downtime. A leading automotive transmission builder used to make this aluminum die cast transmission channel plate at an average rate of 1,000 to 1,500 holes per tap. Eleven 10-24 through holes had to be tapped in each plate. Production was low due to excessive tool breakage and downtime.

When the transmission builder changed to Besly 10-24 B-4 X-Press Taps, they averaged 59,450 holes per tap. Tool life increased 40 to 1. Production went up. Tap breakage, tool costs, and downtime descended sharply.

UNIQUE CAM-RELIEF DESIGN with taper point enables X-Press Taps to excel conventional cutting taps for faster production and longer life. Chips eliminated because the X-Press Tap cold-forms internal threads without cutting. Breakage is less. More pieces are tapped per hour.

Besly X-Press Taps are ideal for either blind or through holes and are recommended for copper, brass, zinc, leaded steels, aluminum, lead, die castings, and other ductile metals.

Cross-section showing unique cam-relief design



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For such operations as:

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CHICAGO 13, ILLINOIS

155

NEW SHOP EQUIPMENT

Dragline carts have pressure sensitive bumpers for automatic switching and greater safety on tow line systems. The new bumper mechanisms are designed for automatic switching from one tow line to another, automatic stopping or accumulation of trucks on a moving tow line conveyor, and automatic engagement of the truck to the tow line.

SI Handling Systems, Inc, PO Box 70, Easton, Pa

MORE DATA? Circle 118, inside back cover

Layout fluid is now available in seven contrasting colors and free samples may be obtained by writing the manufacturer on company letterhead. The fluid has an adhesive agent which will adhere to almost any metal surface for machining and layout operations.

Dayton Rogers Mfg Co, 2821 13th Ave, South, Minneapolis 7, Minn

MORE DATA? Circle 119, inside back cover

Hard facing welding alloy, Rexweld 66, is designed for hot work applications such as drop hammer forging dies. It is a cast nickel-chromium-molybdenum-tungsten alloy which is highly resistant to thermo-shock, and impact and compressive loads at high temperatures. According to the manufacturer, this alloy has 600% longer life in its primary application than comparable materials.

Crucible Steel Co of America, Oliver Bldg, Pittsburgh 22, Pa

MORE DATA? Circle 120, inside back cover

"Of course I have bad references! Why do you think I'm looking for a job?"

You never knew you could do so many things with MODERN ABRASIVES!

Say goodbye to many older, costlier metal working methods

TODAY, use Brightboy, the modern finishing medium that will perform many types of work previously unrelated with abrasive uses.

Brightboy's wide scope begins where conventional abrasives leave off. Its unique working action results from rubber and Silicon Carbide or Aluminum Oxide abrasive grains working simultaneously: BURRING, CLEANING, FINISHING, POLISHING, *in a single-step operation!* Readily available STOCK grains and textures are JOB-MATCHED to *your job!*

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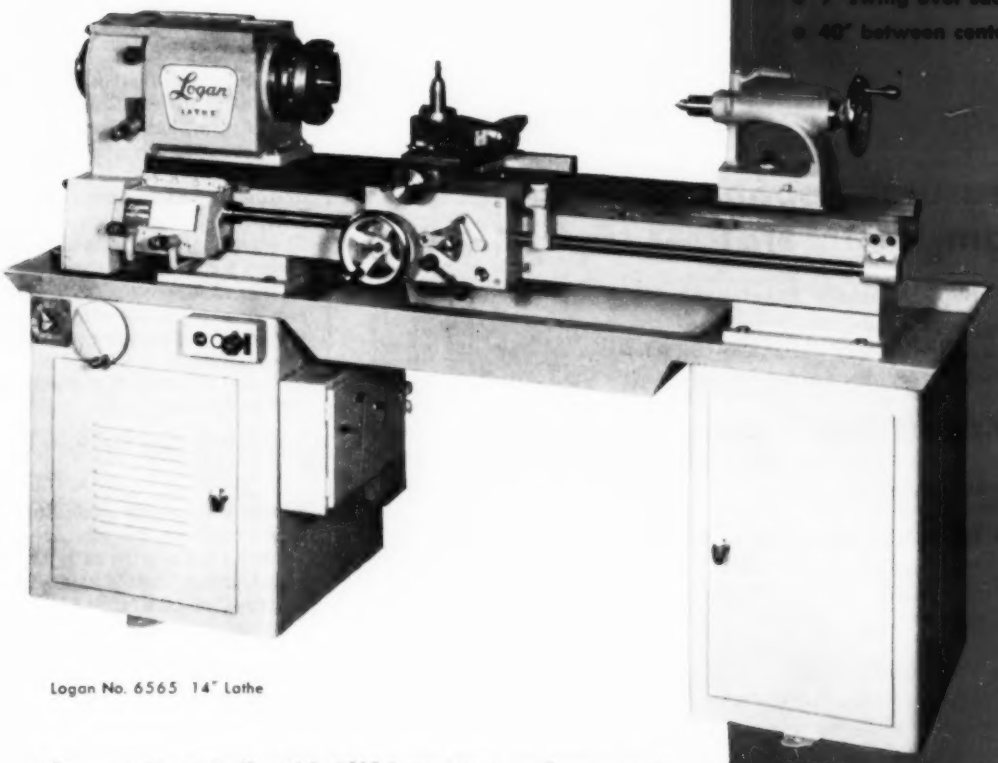
its specifications add up to a capacity for hard work

Logan 14" Lathe

- Spindle speeds up to 2000 rpm.
- 1⅛" Levermatic collet chuck capacity
- 14⅝" swing over bed
- 9" swing over saddle
- 40" between centers

Logan designs greater reliability and accuracy, and longer life into its lathes by a generous combination of high-quality features. For instance—



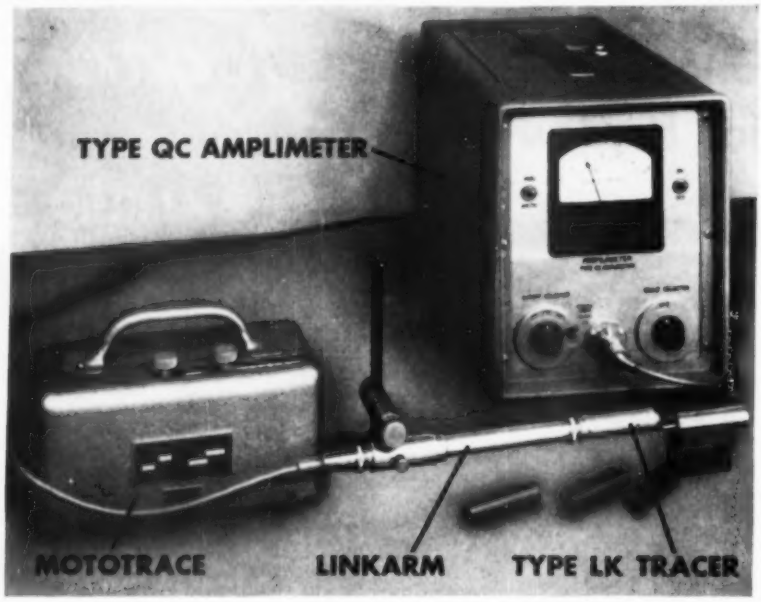
Logan No. 6565 14" Lathe

- An oversize spindle with 1⅝" bore turns on four super-precision ball bearings with built-in preload
- A variable-speed drive lets you change speed while work is turning—without shifting belts
- A warp-free lathe bed with high, strong walls braced by oversize ribs to withstand heaviest stresses; two V-ways and two flat ways are flame-hardened and precision-ground.

There are many more reasons why this and other Logan Lathes have a greater capacity for hard work. The specifications tell the story. Write for literature and complete information

LOGAN ENGINEERING CO. Dept. G-359 4901 Lawrence Ave., Chicago 30, Ill.

NEW! Profilometer® GROUP III



Measures Roughness of Surfaces from 1/8" to Flat — ID and OD

THIS shop equipment handles an exceptionally wide range of roughness measurement—with *proven Profilometer accuracy.* It is lightweight and portable — built for use by shop personnel — and includes the following items:

NEW Type LK Tracer — Measures on ID's and OD's as small as 1/8" — flats — tapers — narrow splines — gear teeth. Passes through a 1/4" hole.

NEW Type QC Amplimeter — Shows roughness from 0 to 1000 microinches (arithmetical or r.m.s.) on an easy-to-read meter. Has 3 standard roughness width cutoffs. Factory-calibrated for dependability.

Mototrace and Linkarm — Give the Tracer a steady support and smooth motion, essential to dependable measurement. No operator skill required.

FREE LITERATURE gives details. Write for it. And, without obligation, let us arrange for a demonstration in your plant. We have representatives in principal industrial centers throughout the Free World.

Remember: You can DEPEND on the PROFILOMETER — first in surface roughness measurement since 1936.

Profilometer is a registered trade-mark.

MMC® MICROMETRICAL MANUFACTURING COMPANY

351 S. MAIN ST. ANN ARBOR, MICHIGAN

NEW SHOP EQUIPMENT

Featherweight locknut has a tensile strength of 220,000 psi and weighs only 60% as much as comparable aircraft self-locking nuts. Squareness is held to a maximum 0.003 in. total indicator reading instead of the standard 0.005 to 0.010 in. The difference, according to the manufacturer, may be enough to extend the fatigue life of a heavily stressed bolt as much as 200%. The FN-22 locknut is available in sizes of 1/4 through 1/2 in., cadmium plated, with or without molybdenum disulfide coating, and can be used at temperatures up to 550 F.

Standard Pressed Steel Co, Jenkintown, Pa

MORE DATA? Circle 121, inside back cover

Transmission, available as optional equipment for the Challenger 60, 70, and 80 pneumatic-tire lift trucks in the 6000-8000-lb capacity range, is designed Hystamatic. It is a hydraulically shifted, constant mesh unit with integral torque converter. The two speed ranges forward and two in reverse are operator-selected by means of levers. All components are in a single housing mounted to the engine as an integral part of the power train.

Hyster Co, 2902 N E Clackamas St, Portland 8, Ore

MORE DATA? Circle 122, inside back cover

Aluminum - oxide grinding disks, called Spitfires, are solvent- and water-proof units with fully reinforced edges and a special built-in shape control that eliminates limpness and disintegration due to excessive grit loss. They are available in Special, Standard, and Heavy-Duty models

"And if you can turn out 50 parts a day, there's a little something in it for you . . ."

for wide range of grinding and finishing applications. Made in grit sizes 16 through 180, diameters include 6, 7, 8, and 9⅛ in., with ½ and ⅞-in. arbor holders. They are shipped plain unless order is marked "Slotted."

Abrasive Products, Inc, Pearl St, South Braintree 85, Mass

MORE DATA? Circle 123, inside back cover

Gear measuring wires are offered in a special kit designed to protect the delicate wires and assure safe storage. A line of 23, 32, 48, 64, 72, 96, 120, and 200-pitch measuring wires is available.

PIC Design Corp, Sub of Benrus Watch Co, Inc, 477 Atlantic Ave, E Rockaway, LI, NY

MORE DATA? Circle 124, inside back cover

Drawing, drilling and tapping oil, Tuf Draw Compound No. 234, is a viscous, honey-colored liquid that has been used in such applications as drawing automobile headlight assemblies, bumper guards, door hinges, and other severe drawing and stamping applications. In addition, it has been used in drilling and tapping stainless steel. It contains no sulfur or other ingredients that can stain or corrode metal parts.

Franklin Oil & Gas Co, 34-40 S Park St, Bedford, Ohio

MORE DATA? Circle 125, inside back cover

Pillow block bearings with a rubber cushion between the bearing's outer ring and the pillow block housing are designed for applications where extremely quiet operation is essential. The units are available in five shaft sizes from ½ in. through 1 in.

Hoover Ball and Bearing Co, 5400 S State Rd, Ann Arbor, Mich

MORE DATA? Circle 126, inside back cover

Solid carbide drills, used in production drilling of nonferrous and nonmetallic materials and some alloy steels, feature a limited deflection design for accurate on-size drilling. C30 series drills maintain body tolerances of + 0.0000 in., —0.0005 in. and shank tolerances of + 0.000 in., —0.001 in.

M A Ford Mfg Co, 1545 Rockingham Rd, Davenport, Iowa

MORE DATA? Circle 127, inside back cover

HIS JOB

....TO BUILD YOUR PROFITS!

THE *Roto-Finish* CUSTOMER'S MAN

There's nothing unique about stressing product quality. But, at Roto-Finish we have an added incentive. The success of the Roto-Finish Customer's Man *depends* on providing the kind of dependable, mass-production finishing service which builds customer satisfaction, and results in a steady repeat business.

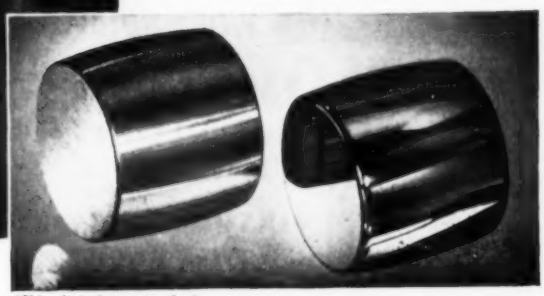
TRIAL AND ERROR FINISHING IS COSTLY

If you're now barrel finishing, our Customer's Man will welcome an opportunity to work with you in your own plant to show you how to get the finish you want, faster, and at lower cost.

If you're hand finishing, he can show you how to save up to 80% of your present finishing costs.

WANT PROOF? Then write or phone your Roto-Finish Customer's Man today.

ROTO-FINISH CASE HISTORY



*This photo is unretouched.

MATERIAL: Bearing steel, 61 Rockwell C Scale.
DIMENSIONS: 1.213" dia. x 1.015".
FINISH BEFORE: Ground to 10 RMS.
FINISH AFTER PROCESSING: 2 to 4 RMS,
(with no dimensional change).

Roto-Finish COMPANY

3723 Milham Road
KALAMAZOO, MICHIGAN
Phone: Fireside 3-5578

ROTO FINISH

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is more modern than...
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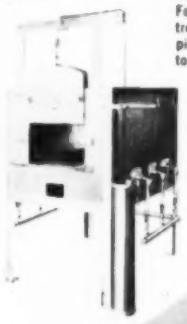
INDUSTRIAL GAS BURNERS & FURNACES
Using Only Low Pressure Gas
for Clean, Fast, Quiet Heat-Up at Lowest Cost!

HIGH SPEED FULL MUFFLE FURNACES
Bench type for heat treating high speed and alloy steels. Temperatures to 2400° F.

LARGE FLOOR TYPE OVEN FURNACES
For universal heat treating of larger pieces. Temperatures to 2000° F.



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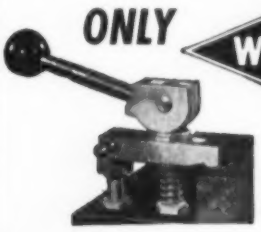

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CIRCLE 295 READER SERVICE CARD

FIELD REPORT...

National Steel Launching $300 Million Expansion Program

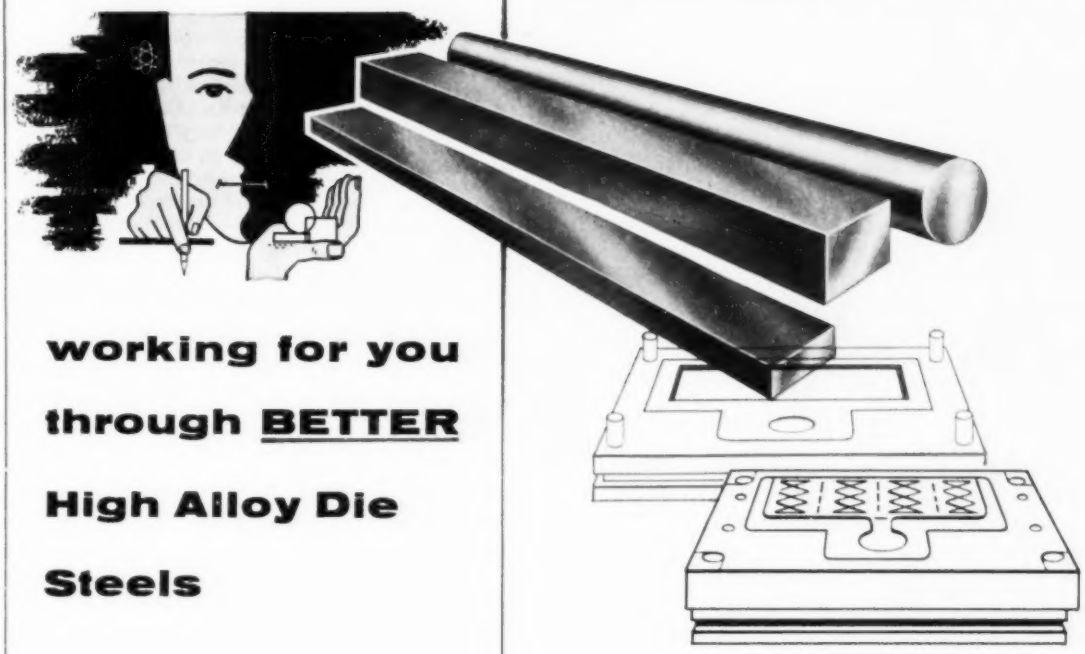
A new steel plant to be built on Lake Michigan, east of Chicago, is part of National Steel Corp's $300 million construction program that'll also include a new steel strip mill and addition of half a million tons of annual steelmaking capacity at National's Detroit subsidiary, Great Lakes Steel Corp. The new plant, to be located in northern Indiana between Gary and Michigan City, will be a finishing mill only, concentrating on the rolling of electrolytic tin plate, galvanized steel coils and sheets, and hot and cold-rolled sheets. The Chicago district unit will be supplied with semi-finished steel from the new facilities to be built at Great Lakes Steel. Additions are also planned for the company's Weirton Steel Div headquartered at Weirton, W Va, with plants at Weirton and Steubenville, Ohio.

Stromberg-Carlson Opens Digimatic Tape Center

The Electronic Control Systems facility of General Dynamics Corp's Stromberg-Carlson Div has opened the first automatic data processing center on the West Coast for the preparation of magnetic tapes for use in operating numerically controlled machine tools. Center, located at ECS headquarters, Los Angeles, will function as a customer service organization to support the preparation of

"I was doing fine, had a small machine shop built up into a $50,000 a year net . . . then my wife decided our twin daughters should have a double wedding."

LATROBE Metalmasters...



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Users of Latrobe's 12% chromium die steels pave the way toward greater production economy. Why? Because, as a result of Latrobe's exclusive DESEGATIZED® process, these steels are free of harmful carbide segregations —fully-uniform to insure maximum die results. Containing evenly-dispersed alloy sulphides, they are easier to machine . . . easier to work!

Put Latrobe Metalmasters to work on your long-run dies through using DESEGATIZED® High Alloy Die Steels . . . steels made by Metalmasters who *know* your production die requirements!

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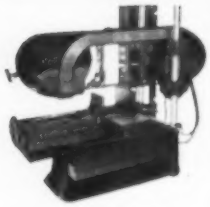
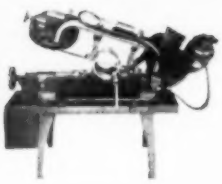
WELLS

METAL CUTTING BAND SAWS



MODEL 1200
Rugged, horizontal band saw for heavy duty production cutting. Completely automatic cutting cycle. Capacity: 12" x 16". Wet cutting standard.

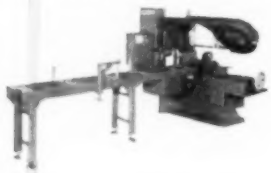
NO. 8
General production or maintenance saw. Capacity 8" x 16". Wet cutting system optional. Model 1000 similar with larger capacity.



MODEL 600
Dependable saw for tool and stock rooms; medium production and utility jobs. Capacity: 6" x 13". Wet cutting optional.

MODEL 58-B
Compact, modestly priced convertible saw. Horizontal capacity: 6" x 10". Vertical—7¾" x 9½". Optional wheels and handle provide complete mobility.

MODEL 49-A
Dual purpose economy saw. Use it as an upright or a horizontal band saw. Capacity: 3½" x 6". Wheels and handle optional.



MODEL 312 Roto-Veyor
Designed specifically for Wells 1200 machines. For automatic feeding on Model 1000 and No. 8 pivoted type saws, Model WJK is available.

Each Wells Saw is designed to perform every cut-off job within its range . . . quickly . . . accurately . . . economically. Wells Band Saws cut continuously at a higher level of efficiency by reducing cut-off time and saving material . . . the thin band blade removes a minimum of stock.

All controls are conveniently located, making the operation of Wells Saws simple, practical, and easy to learn. Blades are stabilized by ball bearing guides and rigid supports, adjustable for capacity. In on-the-job tests, hundreds of duplicate pieces have been cut on Wells Saws with less than .005" variation.

Outstanding performance, quality and big value are yours when you buy WELLS. Write today for NEW BULLETIN 4-C, or see your Wells Distributor.

Wells

The Pioneers of Horizontal
METAL CUTTING BAND SAWS
WELLS MANUFACTURING CORPORATION
505 Roosevelt Road, Three Rivers, Michigan

Field Report . . .

magnetic tapes to customer specifications for the operation of ECS Digimatic contouring control systems, currently being installed and operated in leading aircraft manufacturing plants. The facility will record on magnetic tape all of the data and instructions necessary for cutting out a specified part on a given machine tool. All the machine tool operator has to do is set up the raw material, place the tape on the numerical control console, and press a button. Control system then takes over the operation, guiding the machine's motions and operations for cutting out the desired part.

Firth Sterling Takes Over Kellogg Melting Process

Firth Sterling of Pittsburgh has bought all patents, inventories, and production facilities of the Kellogg ingot process from the M W Kellogg Co, a subsidiary of Pullman Inc. Alloys, produced by the Kellogg process, formerly available only in ingot form, are being widely used in the aircraft and related industries. Firth Sterling, by integrating the process with its own steel facilities, is now offering structural alloy for aircraft and missiles, as well as high-temp alloys. Production plans call for melting alloys in electric arc furnaces; they will be consumably remelted by the Kellogg process under a refining flux, producing ingots which may be forged and rolled into mill products such as billets, as well as hot and cold finished bars.

"Say Henry—take over here will ya, while I go out for coffee?"

Madison Industries Relocation Spells Broader Product Line

Madison Industries, Inc, moved from Muskegon, Mich, to Pawtucket, RI, last July in order to expand plant facilities. Through affiliation with other companies, Madison-Relco Tool Co, and Madison-Faessler Tool Co, Madison is presently offering a broader line of products than ever before. Company produces and sells boring bars, roughing and finishing cutters, gun drills, trepanning heads and bits, as well as other cutting tools. It's still owned by the same interests as it was when it operated in Muskegon, and is actively selling its products in the US and abroad through the same representatives.

Pratt & Whitney to Handle Sales of Wade Lathes

P&W, West Hartford, Conn, has been named an official sales agency for the line of precision lathes manufactured by Wade Tool Co, Waltham, Mass. Machines will be made available through factory-direct representatives working out of P&W branch offices located in principal cities throughout the country. P&W application engineering service will be available to all purchasers.

Vauxhall Going to Overtime

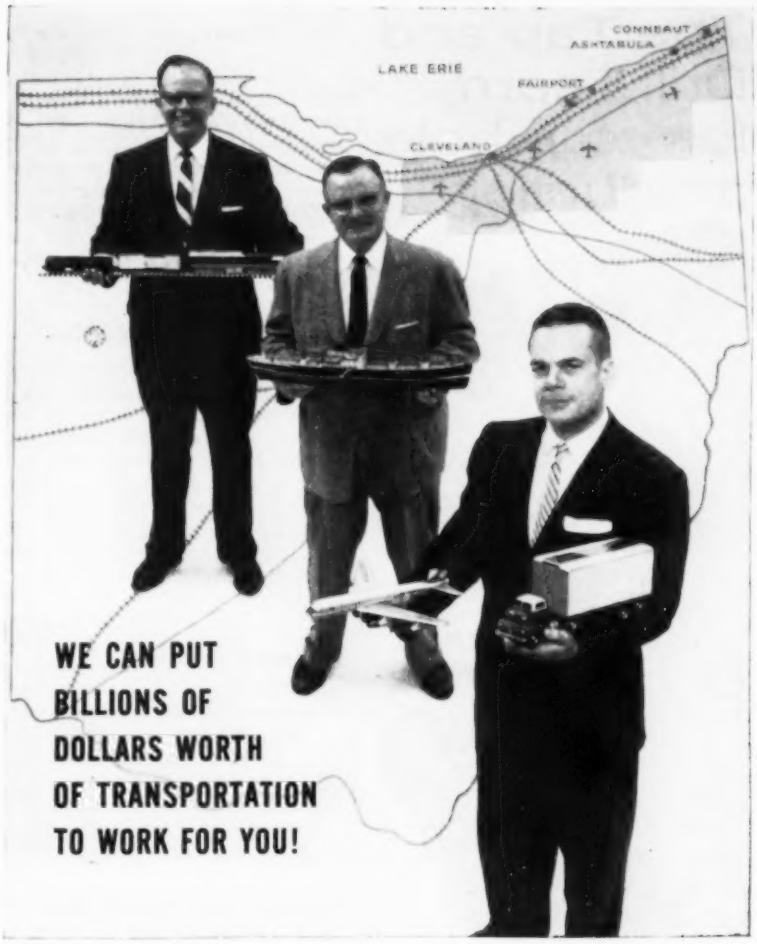
Vauxhall Motors Ltd, a GM subsidiary, and one of Britain's Big Five auto manufacturers, reports that it expects to start overtime work to cope with rising demand for its cars, especially from the US and Canada. And production schedules for early part of this year indicate that additions will have to be made to the labor force. Orders from this country and Canada are double the volume of a year ago.

Air Force Contract to Bendix

Eclipse-Pioneer Division of Bendix Aviation, Detroit, has a $9.4 million order for production of air-data computers. The computers, which collect data and feed it to instruments and various systems, will be installed in the McDonnell F-101 and Republic F-105 fighters.

Massey-Ferguson Goes Bullish

M-F is offering some $12.7 million for F Perkins Ltd, British diesel engine company. Perkins has recommended that its shareholders take the bid which must have a 90% acceptance and British Treasury approval. Massey-Ferguson is also negotiating with



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We'd like to tell you more about transportation in Northeast Ohio—and about the dozens of other advantages The Best Location in the Nation offers as a prospective site for your plant or business headquarters.

We carefully study all phases of business in Northeast Ohio and constantly revise our information to keep abreast of the vast expansion now taking place and of the future possibilities it offers.

If you want the most authoritative, the most complete and the newest information about your future in The Best Location in the Nation write today to Richard L. DeChant, Mgr., Area Development Dept., Room 330, The Cleveland Electric Illuminating Company, The Illuminating Building, Cleveland, Ohio. Free booklets on "Water," "Chemicals," "Transportation," "Research," are available. Also comprehensive report: "Production Center for Defense."

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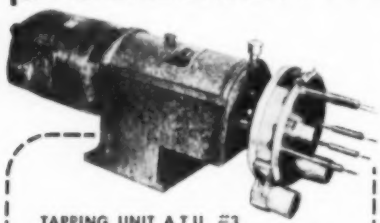
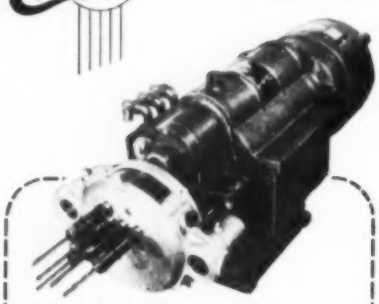
The Tap and Drill Team for your hole production . . .



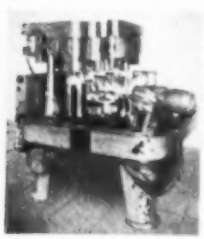
TAPPING UNIT A.T.U. #3
Completely self-contained all-electric lead screw precision unit. Quickly interchangeable for fast single or multiple spindle head operation. With forward and reverse electro-magnetic clutches and variable torque control.

Ettco-Emrick **TAP & DRILL TWINS**



DRILLING UNIT D.U. #2
Completely self-contained precision unit with powerful air feed and hydraulic control. Quickly interchangeable for fast single or multiple spindle head operation.

Used singly or in combination they offer the flexibility and adaptability to meet modern drilling and tapping requirements. When combined with Ettco-Emrick multiple spindle heads they'll set new standards of precision, speed and economy.



SPECIAL MACHINES
Building the Twins into high production special machines is simple, because all units are electrically controlled and all components are standardized equipment. We can supply the assembly complete with tooling — or you can do it in your own plant.
Write for details

Authorized distributors in U.S. and Canada

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The only full line manufacturer covering the entire small hole field: Tapping Attachments • Multiple Heads • Drilling & Tapping Units and Machines • Special Machines • Indexing Fixtures • Tap & Drill Chucks

Field Report . . .

Standard Motor Co for purchase of Standard's tractor-making plant. M-F stated recently that it wouldn't renew its contract with Standard because it wanted to make its own tractors in Britain "from A to Z." If both Standard and Perkins deals go through, Massey will be all set for this.

Telecomputing Gets Add-Ons

The Los Angeles corporation has add-on contracts from Western Electric Co totaling $1.6 million for production of precision gyros to be used in both the Nike-Hercules and Nike-Ajax missiles. New order brings total of contracts received from WE on these missile programs to $4.5 million. Work will be done at Telecomputing's Whitaker Gyro Div, Van Nuys, Calif.

Job Lapping Service

Abrading Systems Co, manufacturer of the Speedlap machine, has opened a branch plant in the Los Angeles area. Facility, equipped with company's machines, makes lapgrinding available to west coast manufacturers. Office is located at 849 Mission St, South Pasadena.

Japanese Auto Makers Aim At 240,000 for 1959

Automobile Industry Association in Tokyo has set its production target for 1959 at 240,000, an increase of 53,000 vehicles or a 28% boost over the estimated total output for the current fiscal year ending in April. To-

"Things could be worse ya know . . . you could be in business for yourself!"

NEED TUBULAR RIVETS IN A HURRY ?

NEW ENGLAND DIVISION
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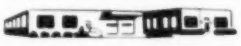
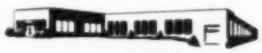
PENN DIVISION
Hatboro, Pennsylvania (Osborn 5-4560)



ILLINOIS DIVISION
Aurora, Illinois (Aurora 2-4278)



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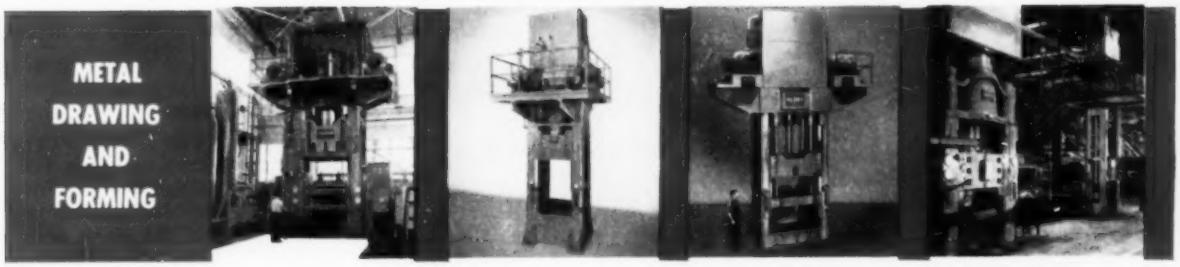
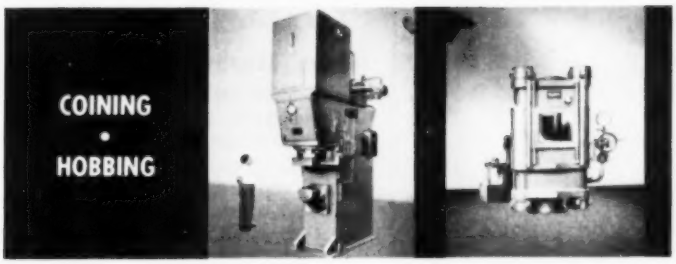
For YOU, too . . .

Elmes can turn pressing problems into profit-making performance!

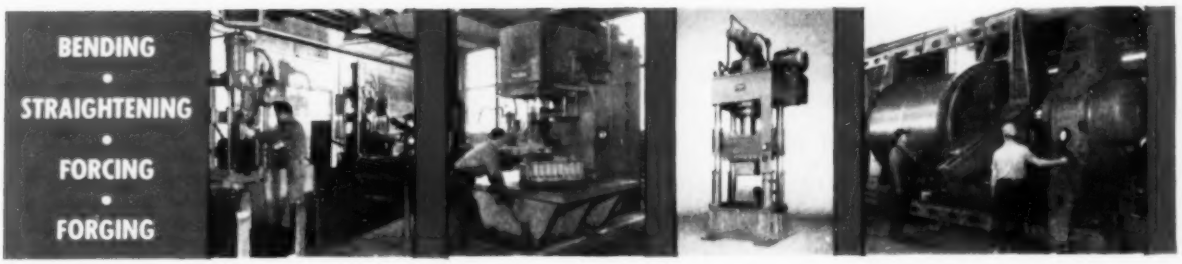




Elmes Engineering vision and know-how have provided hundreds of cost-reducing press installations like these during more than 60 years of leadership in specialized hydraulic service.

In some cases, a standard-design Elmes® Press met all the job needs. In others, simple modifications were made in the basic press design. In still others, a special "custom built" press was developed to meet unusual production requirements. But in every case the press was Elmes "Job-Fitted"—*the right press for the job.*

Elmes experience and ingenuity can bring the same profit-producing transformation into your shop. Talk it over with your Elmes Distributor, or write us direct.



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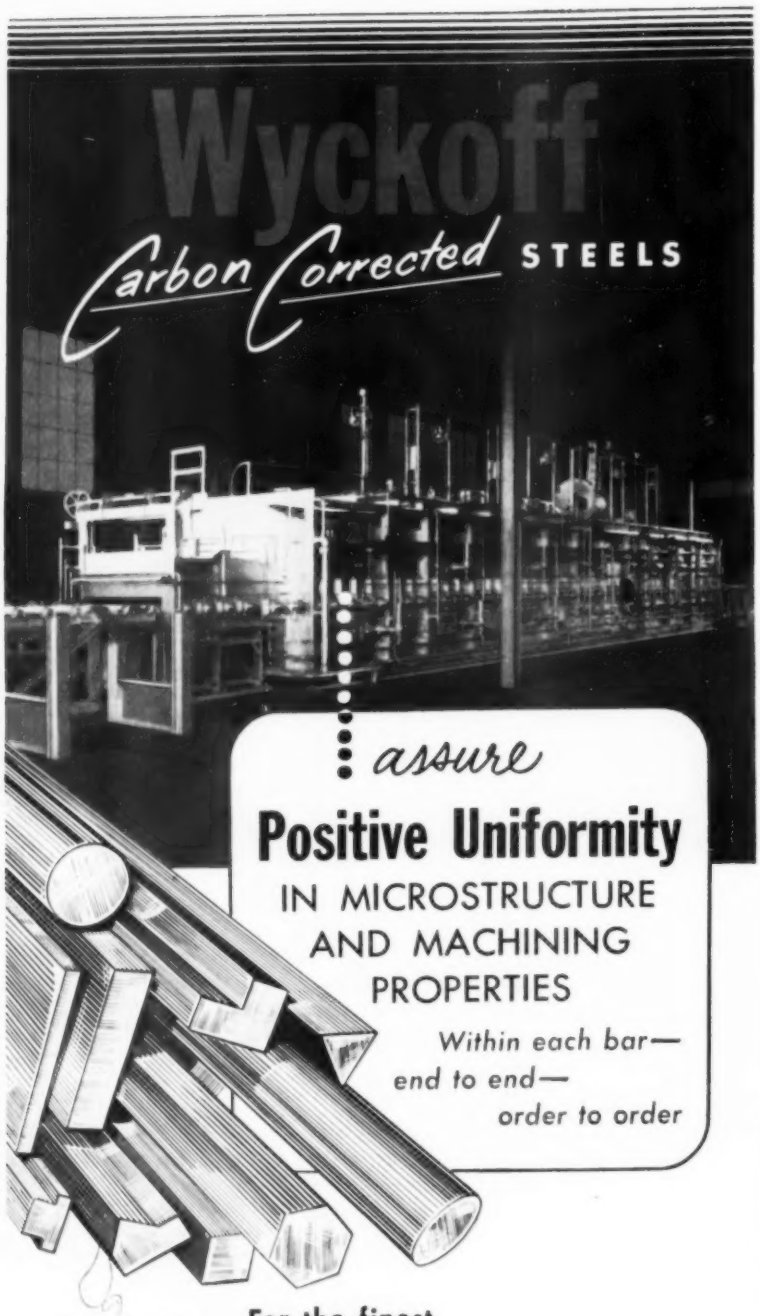

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Works: Ambridge, Pa.—Chicago, Ill., Newark, N.J.—Putnam, Conn.

Field Report . . .

tal 1959 output will include 49,700 standard size trucks, 8800 buses, 69,000 passenger cars, and 12,500 small trucks. As of Nov 30 Japan exported 1424 passenger cars to the US. By the end of April, exports of Japanese cars are expected to go over 2000. According to an unconfirmed report, US may purchase 15-16,000 Japanese trucks to replace vehicles supplied to Southeast Asian countries during the Pacific War.

Air Force Will Soon Begin . . .

. . . negotiations with Northrop Corp for contractual coverage of a program to develop a lightweight multipurpose jet fighter for possible use by allied countries. The plane, designated N-156F, is a twin-engine aircraft said to feature high performance and economy of operation and maintenance. Northrop has been carrying on this project in parallel with the Air Force T-38 program.

Jeep Plant for Holland

Willys-Overland Export Corp has contracted for Kemper en van Twist of Dordrecht to assemble and distribute its Jeep vehicles in Holland. There are presently ten Jeep dealers there. Willys now has 19 assembly or manufacturing plants in foreign countries.

Hughes Acquires Tube Company

Assets of Vacuum Tube Products Co, Oceanside, Calif, have been purchased by Hughes Aircraft Co, Culver City. Vacuum will continue to market and produce its lines of vacuum tubes, precision electronic welding equipment, diodes, gages, controls, and timers in existing plants under the same management.

Simplex Nail & Mfg Co . . .

. . . has moved its operations from Detroit to Americus, Ga. The 6400 sq-ft factory houses 25 automatic cutting machines for production of roofing nails. Labor problems in Michigan contributed to the firm's decision to relocate in Georgia, according to President Marvin King.

Linde Building Ala Chemical Plant

Large liquid oxygen and nitrogen producing plant will be put up near Huntsville, Ala, in the vicinity of the Redstone Arsenal, by Linde Co, Division of Union Carbide Corp. Facility, which will be capable of turn-

ing out 180,000,000 cu ft of oxygen and nitrogen a month, will be completed early in 1960. Products will be used by southern aircraft and missile installations as well as the steel, chemical, petroleum and food industries of the South.

Well, TVA Saved Money, Didn't It?

TVA's award of a $12 million contract to a British firm for supplying a 500,000 kw turbogenerator for the Colbert Steam plant near Tuscumbia, Ala, has caused some amount of harrumphing roundabout. A factor guiding the decision: Bid of C A Parsons & Co of Newcastle upon Tyne, was $12,095,800. General Electric and Westinghouse bid $17,633,000 for the same generator. New Colbert unit is scheduled to begin operation by October 1962; construction will start next January.

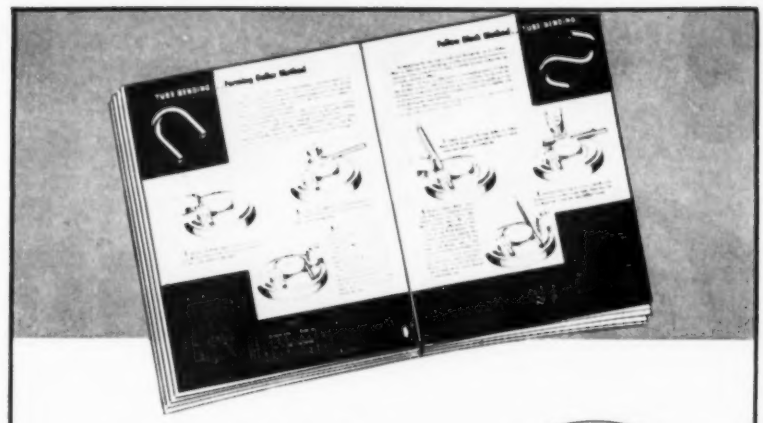
The Carolinas

Western Electric Co's Winston-Salem works is manufacturing electronic apparatus for the Air Force Titan. First complete ground guidance radar system manufactured in NC for this missile was delivered to AF in November.

Metal Treating Corp has just begun operations in Charlotte. Company will provide commercial precision heat treating facilities.

Homelite, Division of Textron, Inc, Port Chester, NY, has broken ground at Greer, SC for its $3 million 150,000 sq-ft plant. New factory, scheduled for completion in July, will make outboard motors, pumps, portable lighting plants. Employment will be between 400 and 500 when operations reach full capacity.

"I'd like a word with you, Burrow!"



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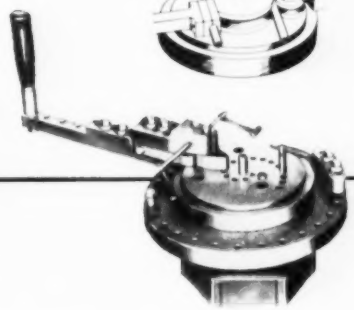
BENDING ...

Free Manual shows techniques of forming round, square, or hex bar stock ... tubing ... channel ... angle ... flat and other materials.

Di-Acro Hydra Power Bender



Di-Acro Hand-Operated Bender

It's easy to bend a wide variety of material when you know how—profitable too because bending can simplify product design—make one curved piece do the job of two or more. Bending can improve product appearance and lower your production costs!

This 32-page illustrated manual shows how to make center eye and off center bends, circles, zero radius bends, scrolls, squares, springs and coils, loops and spirals—all with *one versatile machine*. Booklet also tells how to tool for tubular, channel, angles and other special bending needs.

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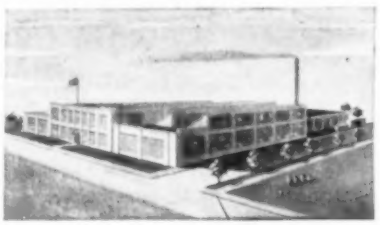

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Field Report . . .

Auto Notes From Russia

Russians soon will see the ZIL-111, a new luxury class passenger car under production at the Lichachev automobile factory. Initial production was reported by Tass which said the new vehicle is a sedan with 200 hp from eight cylinders placed in two rows. The medium size Volga will be modernized this year and supplied with automatic transmission, and the Moskvich 407 will get a four-speed transmission. Tass also reported testing of an unnamed small car with a 20-25 hp aircooled rear engine, capable of a speed of 50 mph.

British Instrument Firm Forms American Affiliate

Hilger & Watts Ltd, one of England's leading manufacturers of engineering, scientific, and survey instruments, has established Hilger & Watts, Inc, Chicago. New organization will take over from the Jarrell-Ash Co of Newtonville, Mass, H&W products in the field of scientific instruments including spectroscopy, colorimetry, interferometry, and allied fields.

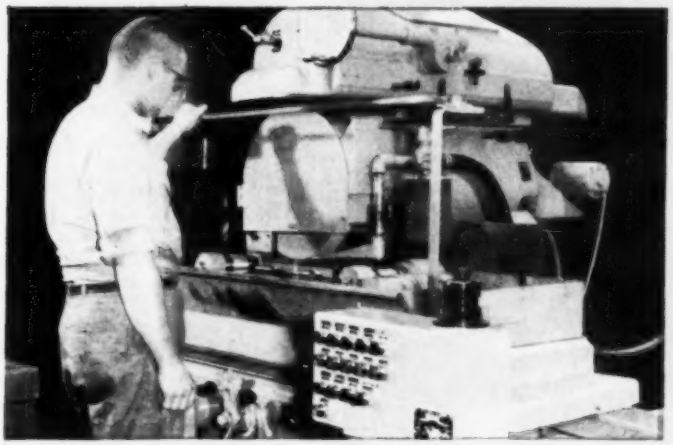
Germany Awards $14.5 Million Aircraft Order to Republic

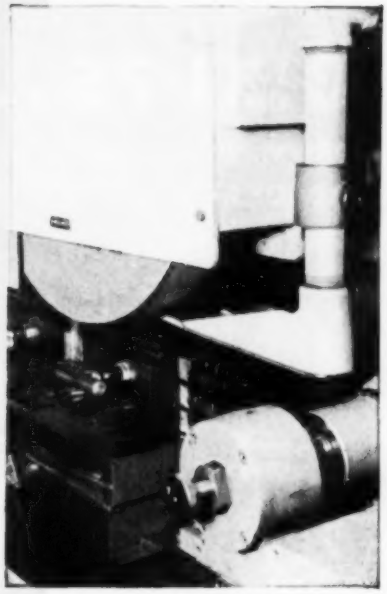
Contract for spare parts for American-built fighter bombers and reconnaissance aircraft has been placed with Republic Aviation (International) S A, a subsidiary, by the Ministry of Defense of the German

"I understand you use dogs to hold work in place on your lathes!"

Thompson — TRUFORMING CUTS COSTS 66%

. . . DOUBLES PRODUCTION AND IMPROVES PRODUCT AT THE OLIVER CORPORATION





In the production of ledger plates, used in the cutter bar of mowing machines, The Oliver Corp. of Chicago, formerly first milled the teeth, then hardened the plate. The hardening process caused distortion and variance in uniformity which impaired the cutting action of the bar.

On the advice of Thompson engineers, a Type BB Truforming Grinder with a 2½" width grinding wheel was installed to process these ledger plates as a finished grinding operation. The plates are now heat treated first and the teeth are then formed by grinding.

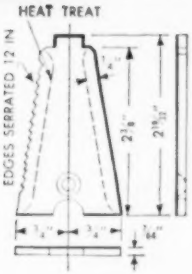
The installation of the Thompson Truforming Grinder has accomplished the following results:

1. **Cut total production costs from $3.18 to $1.06 per 100 pieces.**
2. **Increased the production rate from 1600 to over 3600 pieces per 8-hour shift.**
3. **Provided constant uniformity in the workpieces.**
4. **Eliminated the full-time service of one man.***
5. **A pair of $160.00 milling cutters formerly produced 20,000 pieces. A $60.00 grinding wheel now produces well over 40,000 pieces.**

The leadership of Thompson Truforming Grinders results from 25 years of research and development work in crush form grinding. Today these machines are opening up hundreds of practical, time-saving, profit-improving and cost-cutting applications for industry.

Thompson's engineering experience is available to you without obligation. Write for Catalog T558.

**Automatic machine cycle allows operator time to countersink hole in plate—an operation formerly requiring one man's full time.*



LEDGER PLATE
High Carbon Manganese Steel
Rockwell C52-58

"Keep Thompson in mind for that daily grind"

THE THOMPSON GRINDER CO.
SPRINGFIELD, OHIO

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Now

AUTOMATIC POSITIONING

with the

DIXI 75 horizontal optical jig borer

offers you increased

ACCURACY

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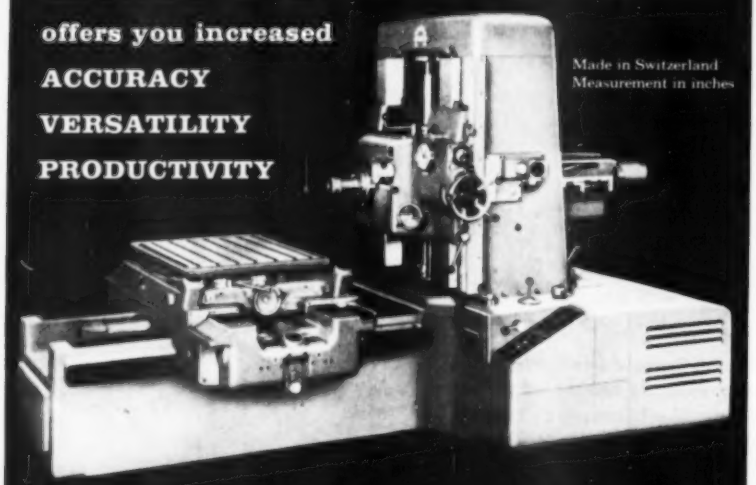

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Measurement in inches

- Automatic positioning can be changed instantly to manual operation
- Projected optical setting — direct reading to .00005" for linear motions and 1 sec. of arc for built-in rotary table. Linear optics provided with adjustable zero reference
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- Increased capacity: table size 39⅜" x 32"; 29⅝" cross travel; 23⅝" longitudinal travel; 25⅝" vertical travel
- Hydraulic feeds and infinitely variable spindle speeds
- Rear support optional

See the DIXI 75 in operation at the
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Field Report . . .

Federal Republic. Order covers production of parts for the F-84F Thunderstreak jet fighter-bombers and the RF-84F Thunderflash jet reconnaissance planes now in service with the German Air Force. European industries will turn out a large portion of the parts. Fabrication of more than 1500 separate items will be done on a subcontract basis. It's estimated that it will take two years to complete the contract.

Albany Products Purchase

The South Norwalk, Conn, fastener firm has purchased the entire inventory of precision stainless-steel screws of H M Eckert Co, Richmond Hill, LI, NY. Over three million pieces, machined from bar, Class 3A fit, are involved.

Philco Sells British Subsidiary

Thorn Electrical Industries Ltd, London, has purchased all of the issued capital stock of Philco (Overseas) Ltd, Philco Corp's radio and television manufacturing unit in Great Britain. Thorn will manufacture and sell the products under the Philco name.

Martin Gets Atom Contract

Martin Co, Baltimore, has a $6 million order from the Atomic Energy Commission to design and build a

(Continued on page 195)

"Trouble is, my boss doesn't have a good nature to take advantage of!"

Man's Eternal Struggle with the Machine

THE GUIDED MISSILE IS A VAST COMPLEXITY OF SYSTEMS FOR GUIDANCE, TELEMETERING, CONTROL, PROPULSION, ETC

Would you like to know a simple way to build a guided missile?

Sure you would . . . and so would everybody else!

Obviously, there *isn't any simple way* to build a guided missile. And, what's more, there may *never* be one.

But . . .

Research and development people just like yours are proving every day that there *is* a *simpler* way! Constantly, technological improvements are being developed in your own laboratories as well as in laboratories of such organizations as Sciaky.

Sciaky operates the only independent, fully staffed and equipped Research Center dedicated to the development of the resistance welding techniques of fabrication.

That's why the Sciaky Research Center has become a major source to all manufacturers for (1) basic and advanced research, (2) development of experimental tooling and fixturing, (3) assembly of experimental and prototype models, (4) pilot production runs, etc.

Why take less than the full advantage of consulting with Sciaky engineers on your research and development projects. You will receive the full support of (1) the knowledge and experience that has produced almost all the basic technological advances to resistance welding equipment, (2) a complete array of testing and inspection apparatus, and (3) the most unusual collection of the most advanced resistance welding machines of all types, as well as all the other machine shop, fabricating facilities, etc., necessary to a research function of this magnitude.

Write today under your company letterhead for your copy of the facilities brochure describing the Sciaky Research Center in detail. No obligation, of course.

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SCIAKY BROS., INC. 4933 W. 67th Street, Chicago 38, Illinois • POrtsmouth 7-5600

NEW! PLUG-IN ROLLER PLUNGER LIMIT SWITCH WITH Exclusive MICROMETER ADJUSTMENT

This new Square D roller-plunger plug-in limit switch is built for rugged machine tool applications—designed for cam-type operation and not restricted to direct, in-line approach of the actuator. Uses same field-proven precision switch mechanism as roller-arm type for long reliable operation. Moreover, it provides these important features:

Micrometer adjustment for fine adjustment of the roller after the switch has been mounted and wired. 1/8" movement of the roller plunger eliminates expensive cam shimming and adjustment.

Operating direction can be changed 90° for added flexibility. Roller plunger can be set either parallel or perpendicular to the base. No tools required.

Cam-type operation is possible because of the construction of the plunger assembly.

Oil-tight construction for all machine tool applications.

Plug-in construction • Switch plugs in—in seconds.

Easy wiring because all wiring can be done without removing from box.

Reversible plug-in unit can be positioned with roller plunger at either top or bottom.

Write for Bulletin 9007 AW. Address Square D Company, 4001 North Richards Street, Milwaukee 12, Wisconsin

EC&M HEAVY INDUSTRY ELECTRICAL EQUIPMENT...NOW A PART OF THE SQUARE D LINE

SQUARE D COMPANY

Field Report . . .

nuclear power plant to be installed at Sundance AF Base in Wyoming. Plant will be built in sections for easy transport.

Penn Machine Buys Malleable Iron Co

Penn Machine Co, Johnston, Penna, producer of mining machine parts, has purchased the Malleable Iron Co of Canton, Ohio, manufacturer of metal castings for the auto and mine equipment producers. Sale price was in excess of $1 million. Transaction also gives Penn control of the Canton Manufacturing Co, a Malleable subsidiary.

I-T-E Circuit Breaker Co . . .

. . . has two contracts totaling more than $1 million covering new radar antenna systems. Work will be carried out at the Special Products Division, Philadelphia. Orders are for development of prototypes of a giant early warning antenna system for the DEW line and development and production of a miniaturized seaborne system for the Coast Guard.

Porter Sets Up New Division

New Mouldings Division will manufacture and market the complete line of automative and other metal mouldings formerly produced by Herron - Zimmers Moulding Co, whose plants at Detroit and Frankfort, Ky, were recently purchased by Porter. Company also produces additional products used by home builders and appliance manufacturers.

"If you're too busy to listen to my excuse for botching this job—I'll save it for next time."

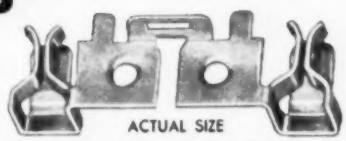
Blanking, Piercing and Preforming in Press

NILSON 4-SLIDE

BLANKS *and* FORMS IN ONE CYCLE!

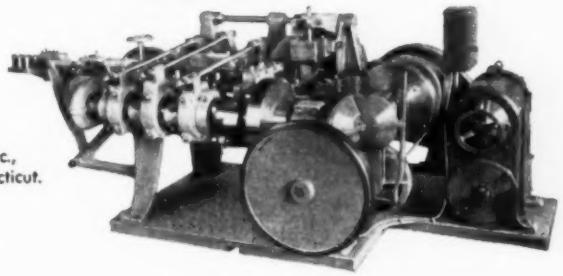
Cutoff

Partial Forming with Slides



ACTUAL SIZE

Final Forming with Slides



Nilson 4-Slide Machine with Built-in Press

MANUFACTURER:
Harvey Hubbell, Inc.,
Bridgeport, Connecticut.

PRODUCT:
Contact Spring.

PRODUCTION:
136 Parts Per Minute.

Harvey Hubbell shifted production of this part from a conventional press and progressive dies to a Nilson 4-Slide with built-in press. The immediate results: elimination of two secondary operations . . . simpler die . . . higher production rate . . . no stripping problems.

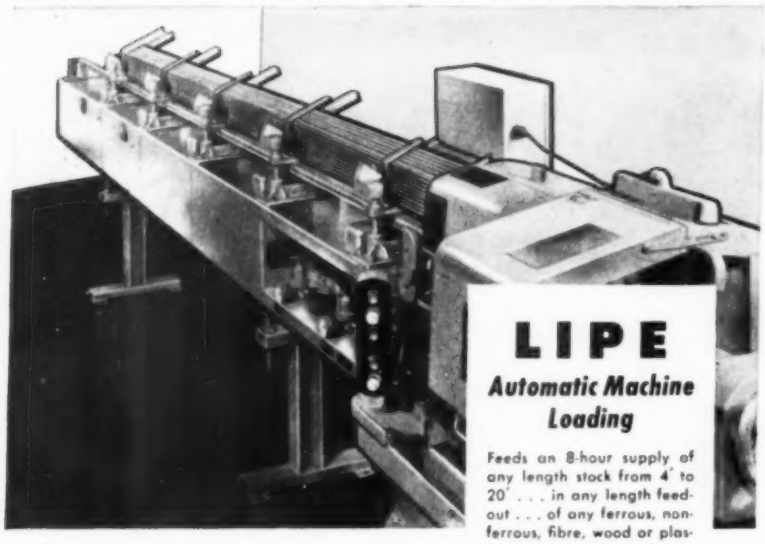
Harvey Hubbell also found that vertical mounting of die makes replacement easy . . . permits automatic disposal of scrap by gravity. And maintenance costs are incredibly low—this machine has been operating for twelve years without major repairs!

Nilson builds 7 models of ribbon metal forming machines, with built-in press sections ranging from 5 to 75 tons capacity. One of these machines may help you bring your stamping methods up-to-date!

Write today for the Nilson General Catalog on Automatic 4-Slide Equipment.

NILSON
THE A. H. NILSON MACHINE CO.
601 Bridgeport Avenue • Shelton, Conn.

AUTOMATIC WIRE & RIBBON METAL FORMING 4-SLIDE MACHINES • WIRE & STOCK REELS • WIRE STRAIGHTENING EQUIPMENT • AUTOMATIC STAPLE FORMING MACHINES • SPECIAL WIRE FORMING EQUIPMENT


LIPE
Automatic Machine Loading
Feeds an 8-hour supply of any length stock from 4' to 20' . . . in any length feed-out . . . of any ferrous, non-ferrous, fibre, wood or plastic material . . . ranging in diameter from 1/16" to 1 1/2".

Continuous Automatic Feed

of bars, rods, tubing in practically every shape used!

LIPE AML Bar Feeds will give you faster, finer production with less scrap and refinishing and a more efficient use of manpower.

They are applicable to a wide variety of machines, including single-spindle automatic screw machines, turret lathes, centerless grinders, abrasive-wheel cut-offs, punch presses, cold headers, die machines and others.

Sold and serviced by franchised distributors in principal industrial areas. Write or wire for complete information.

STOP CUTTING AIR AND YOU START CUTTING COSTS

LIPE-ROLLWAY CORPORATION
SYRACUSE 1, N. Y.

PIONEERS IN PNEUMATIC BAR-FEEDING

Field Report . . .

B&S Opens New Cutter Service

New service has been added by the Cutting Tool Division of Brown & Sharpe Mfg Co, Providence. Complete cutter and tool sharpening service has been opened at 590 Grand Ave, Ridgefield, NJ. Called the Brown & Sharpe Cutter Service Co, it is an independently operated business staffed by factory trained cutting tool specialists.

Du Pont Slashes Prices Of Fibrous Potassium Titanate

Prices for the new lightweight material for insulation against high temperatures have been reduced by $4.50 a pound. Prices of the lump form have been cut from $12 to $7.50; loose fibers, fill, block, mats, and other forms have also been reduced by $4.50. Designed for applications where space and weight are critical, material offers construction advantages for rockets and missiles, aircraft, atomic-powered vehicles, and many industrial applications.

Kaiser Aluminum Plans . . .

. . . a $3 million expansion project at its Trentwood, Wash, plant that will involve a new production line to roll aluminum for cans. Installation will include special finishing, drying, and coiling equipment. Company has for several years conducted research at Trentwood on aluminum containers to compete with tin cans.

"I must have dozed off. What were those instructions you were giving?"

Modern, spacious facilities at Shafer Valve Company.

BARDONS & OLIVER TURRET LATHE CUTS MACHINING TIME IN HALF. . . . . .

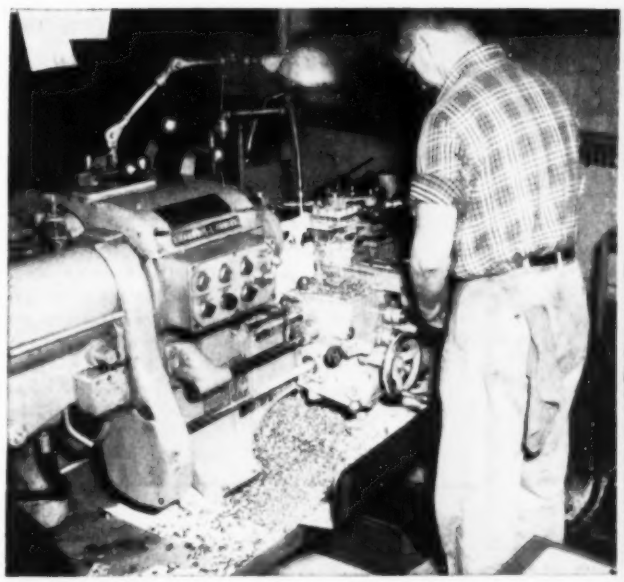
at Shafer Valve Company, Mansfield, Ohio

The Bardons & Oliver No. 3 Universal Turret Lathe is playing an important role in the story of this progressive, fast expanding firm. Over 60 different parts are made on this machine; lot sizes vary from 10 to 1000 pieces; material from brass to stainless steel is machined; and, the turret lathe is used both as a chucker and bar machine.

Operator Martin Hopp reports: "I can produce more with less effort from this machine than from other turret lathes of similar size. I have no trouble holding .001 inches on lengths and diameters."

Vice President Robert Haag reports: "We purchased the Bardons & Oliver Turret Lathe on the basis of this machine's outstanding features of performance and reliability. After using the machine for over a year and a half on a two shift basis, we are entirely satisfied with our choice."

For detailed information on any size turret lathe contact your Bardons & Oliver representative or write the factory direct.

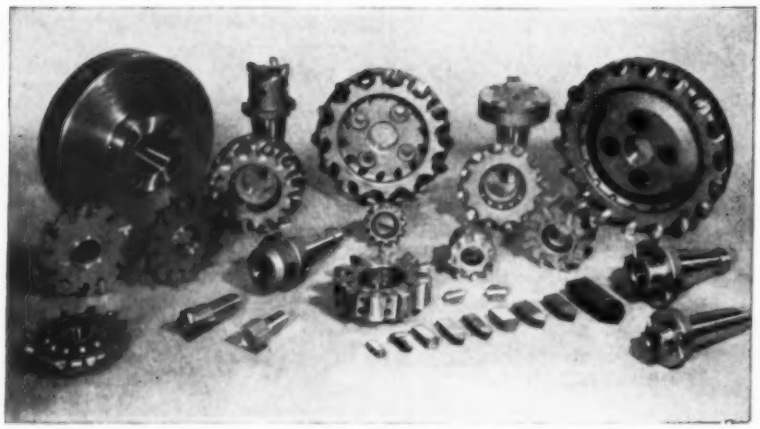


BARDONS & OLIVER

CIRCLE 311 READER SERVICE CARD

BARDONS & OLIVER, INC., 1134 WEST 9th ST., CLEVELAND 13, OHIO

Manufacturers of Turret Lathes and Cutting-Off Lathes



Milling Cutters — End Mills — Blades — Boring Tools — Arbors — Flywheels

These Lovejoy Products can help you Cut Costs!

The entire line of Lovejoy Milling Cutters and Accessories is designed to aid you in getting better production at less cost.

If you are not now using Lovejoy products, we invite you to do so at first opportunity.

Lovejoy precision-engineered tools include:

Inserted-tooth milling cutters (face, side, end, slotting and boring) which feature husky, forged steel housings; exclusive Lovejoy "positive-locking" blade assembly; a variety of dozens of models and hundreds of sizes.

Blades: H.S.S., Vasco Supreme and carbide. These are interchangeable over a wide range of housing sizes, and Type "A" face milling blades will fit any standard Lovejoy Type "A" cutter of 4½" to 24" dia. All Lovejoy blades are carried in stock, ready for immediate shipment. Special cutters are a Lovejoy specialty.

NEW "JOYDEX"

This performance-proved face mill features indexable blades for low cost-per-edge cutting. Exclusive design improvements include — adjustable anvils • extra deep chip flutes • fast, easy indexing • sweep blades for fine finish • double positive, or combination positive and negative rake angles merely by changing blades • rugged, one-piece body • large locking screws. *Try out a new "Joydex" and prove its superiority! ("Joydex" data sheet is yours for the asking).*

Catalogs — include: "Face Mill Catalog No. 31; Side Mill Catalog No. 32; Type "S" Bulletin; Arbor Catalog No. 33; "Speed and Feed" Calculator. Write today for copies desired.

LOVEJOY TOOL COMPANY, INC.
Springfield, Vermont, U.S.A.

Free Literature

To order any of these bulletins, circle corresponding number, inside back cover.

MACHINES AND ATTACHMENTS

1 TAPE-CONTROLLED VERTICAL TURRET LATHE—*Giddings & Lewis, Kaukauna Machine Div, Kaukauna, Wis.* 7-page bulletin VTL-4 describes and illustrates features and advantages of VTLs that incorporate Numeripoint punched tape discrete positioning control system. Operating from a perforated 8-channel tape prepared on a standard electric perforating typewriter, control supervises all feeds, speeds, turret positions, and precision cutting tool positions or end points. Any two VTL heads can be operated from the tape, such as rail and side head, or two rail heads.

2 VERTICAL FOUR-SLIDE—*Torrington Mfg Co, Machine Div, Torrington, Conn.* 6-page bulletin UB-3 gives details on the UB3 Verti-Slide, adapted from the basic design of Meyer, Roth & Pastor of Cologne, Germany. Advantages, previously not available in wire forming equipment, are discussed. Speed range is 75 to 300 pieces per minute; press capacity is 3 tons; stroke, 9/32 in.; machine capacity is: max wire dia, ⅛ in.; max strip width, ⅝ in.; max strip thickness, 1/32 in.

3 VERTICAL BORING AND TURNING MILLS—*Giddings & Lewis Machine Tool Co, G&L and Hypro Div, Fond du Lac, Wis.* 28-page catalog VBM-4 illustrates and describes features of machines available in sizes 54 and 64 in., 6 ft and 6 ft heavy, 7 and 8 ft, 8 and 10 ft heavy, and 12 and 14 ft. Range of 16 feeds covers 54 and 64-in. machines, 0.003 to 0.500; machines 6 ft and larger, 0.004 to 0.750. Specifications and dimension drawings included; optional equipment pictured and discussed.

4 BAR AND TUBE MACHINERY — *Blaw-Knox Co, Foundry & Mill Machinery Div, 300 Sixth Ave, Pittsburgh 22, Penna.* 18-page bulletin 2533-JJ58 covers Medart machinery for billet peeling and chipping, centerless turning, bar and tube straightening, stretch straightening, wire straightening and cutting, and roll grinding. Advantages of this equipment illustrated.

5 DRILLING AND TAPPING MACHINE—*Baush Machine Tool Co, Springfield, Mass.* Illustrated literature provides information on the M-20 vertical mechanical screw feed multiple spindle unit.

"2 + 2 . . . testing . . . 2 + 2 . . . testing . . ."

PORTA-CHECK®
A transistorized portable comparator for fast accurate measurement in both "tenths" and "thousandths" scales.

MODEL AG AIR GAUGE
For checking diameters, dimensions, roundness, etc.

200 SERIES MICROMETER DIAL INDICATOR
One of four sizes. Made to AGD specifications.

NO. 2 DIAL COMPARATOR
For desk, bench or at-the-machine inspection of small parts.

AMES

Masters of Measurement...

For more than half a century, Ames measuring instruments have been regarded as the finest made. Today the constantly growing line of Ames indicators, gauges, micrometers and comparators includes such amazingly accurate instruments as the new Ames "PORTA-CHECK", an electronic comparator which gives accurate readings *in millionths of an inch*; and the new Model AG air gauge—also accurate to millionths of an inch. Wherever precision is *really* important . . . you'll find Ames "masters of measurement" on the job.

Representatives in Principal Cities

B.C. AMES CO.

26 Ames Street, Waltham 54, Mass.

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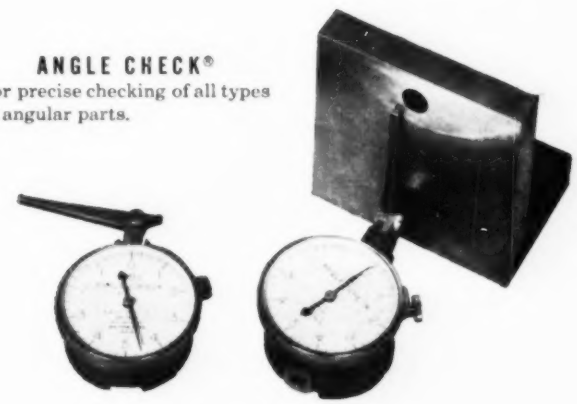
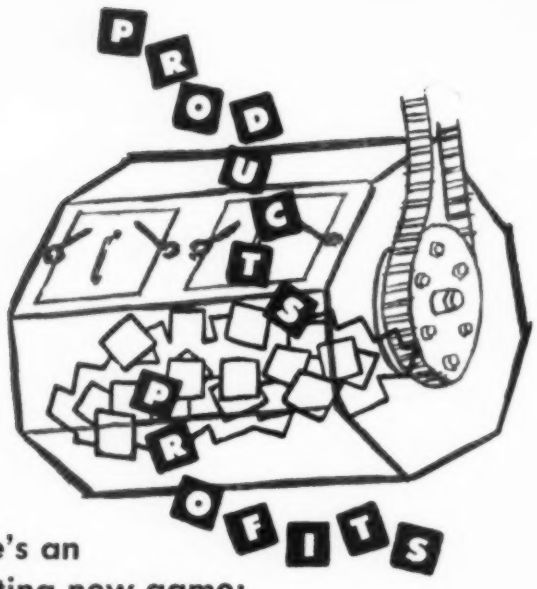
MANUFACTURERS OF MICROMETER DIAL INDICATORS AND GAUGES

ANGLE CHECK®
For precise checking of all types of angular parts.





Here's an exciting new game:

PUT your products in the barrel
TAKE your profits out

One of the greatest money-saving opportunities in metal-working lies in the use of barrels to finish parts by the hundreds in place of conventional methods that finish one part at a time.

Barrel finishing makes easy work of many tough jobs of grinding, deburring and buffing by wheel.

One Oakite customer changed to barrel methods to deburr curved stainless steel strips that are 14 inches long. The cost for deburring 20,000 strips was reduced from $3,000 to $125.00.

FREE For a copy of *"Precision Barrel Finishing"* —containing valuable information on cutting down, deburring, descaling, and burnishing—write to Oakite Products, Inc., 24 Rector Street, New York 6, N. Y.

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Technical Service Representatives in Principal Cities of U. S. and Canada

Free Literature

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Head is bored for (32) 1½-in. dia spindles. Spindle speeds in yoke are through pick-off gears from 130 rpm low to 1050 rpm high.

6 FINISHING MACHINES — *Foote-Burt Co, Schraner Div, Cleveland 8, Ohio.* 8-page catalog 512 illustrates and describes complete Footburt-Schraner line of bearing-surface finishing machines for straight shafts, crankshafts, and camshafts. Included are models A, B, HD, and SFA lapping units; models A, B, HD, DER, and SER fillet-rolling machines; and models SF and SFB machines which can lap, fillet roll, or roll burnish. Use of coated-abrasive cloth on all lapping units makes possible the lapping of both bearing surfaces and adjacent fillets.

7 DEEP THROAT PUNCHING PRESSES — *Minster Machine Co, Minster, Ohio.* Illustrated bulletin 13 contains data on Series 20 for light and medium cutting, punching, and flanging operations on large pieces. Covers construction and operating features plus specifications on units in 15, 25, and 35-ton capacities.

8 PRECISION JIG GRINDER—*Moore Special Tool Co, 800 Union Ave, Bridgeport 7, Conn.* Illustrated brochure describes exceptional locational accuracy of the new No. 3 unit. After holes were bored on a No. 3 Moore jig borer, a 4-hole steel plate was ground on the No. 3 jig grinder. Locations were then measured on the Moore universal measuring machine. Readings showed a max difference in measurement of 30 millionths. Brochure includes detailed specifications and performance data.

9 LARGE SWING LATHE — *South Bend Lathe Works, 425 E Madison St, South Bend 22, Ind.* Illustrated bulletin 5830 contains information on the 16-24 in. general purpose unit that has 25⅛-in. swing and up to 126 in. between centers; choice of 4-step cone pulley for 8 or 16 spindle speeds or 3-step cone pulley for 6 or 12 speeds.

10 SEMI-AUTOMATIC LATHE — *Carl Hirschmann Co, 30 Park Ave, Manhasset, NY.* 4-page brochure gives details on the Kummer high-precision MR-6020

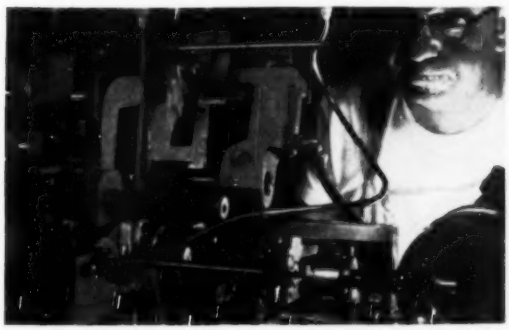
"I'd have stayed home this morning, but I was afraid my wife would put me to work."

22½ hours per day.... 7 days a week...

and no maintenance problems

These 2 BAKER AUTOMATIC BAR MACHINES have been operating continuously since their installation 6 months ago in a major New York appliance plant. "We have encountered no maintenance problems." says a company spokesman. This is RELIABILITY IN ACTION, proving steady, long-term BAKER economy.

Further production benefits have been gained through reduction of change-over time, cutting the operation from 16 hours to as little as 4 hours. A separate washing step and a hand-burring operation have also been eliminated. BAKER electronic speed control is another reason ". . . why we have ordered the third machine for use here . . ." says this New York BAKER customer. For additional details, write to BAKER BROTHERS, INC., Dept. AB-359, 1000 POST STREET, TOLEDO 10, OHIO.



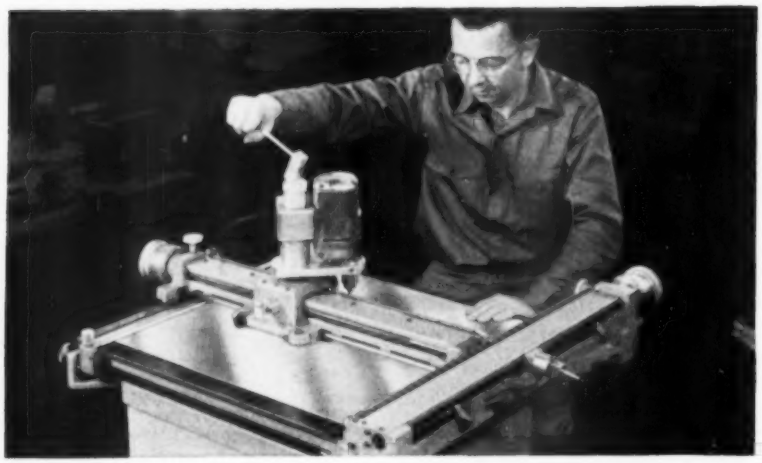
Each BAKER cuts, threads and burrs 720 Heater Motor Shafts per hour, eliminating the need for manual finishing steps.

BAKER®

AUTOMATIC BAR MACHINES

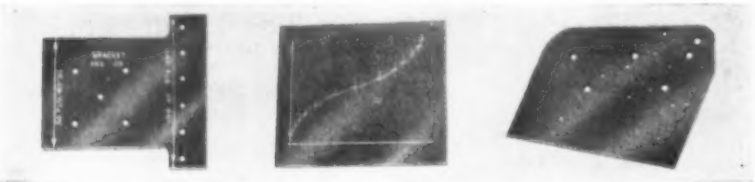
STANDARD AND SPECIAL DRILLING AND TAPPING MACHINES • COMPRESSION MOLDING MACHINES

layout and template making time cut in half...



THE NEW STRIPPIT FLEX-O-DRILL

- **DRILLS, REAMS, SCRIBES, CENTER PUNCHES** to ± 0.002" WITHOUT base line drawing or height gauge layout!
- **EASY, ACCURATE POSITIONING**—quickly set to any reference point and to nearest 0.100" by adjustable steel tapes reading in both directions from zero. Micrometric gauges then bring settings to nearest 0.001". No optical scanning device needed.
- **LASTING ACCURACY!** Table is an actual ground surface plate. Bridge assembly is of heavy, accurately machined castings. Lead screws are precision ground and engaged only during micrometric gauge settings to minimize wear. All parts are corrosion-resistant. Bearings are protected against dust and chips by felt shields. Drill motor is heavy-duty industrial type.
- **¼" CAPACITY** in mild steel — stock up to 24" width, any length.
- **ALSO A PROVEN MONEY-SAVER** on pilot runs, low unit production.



Template drilled by Flex-O-Drill | *Layout scribed by Flex-O-Drill* | *Flex-O-Drill work piece*

WRITE FOR LITERATURE TODAY, and an actual demonstration at your plant:

WALES STRIPPIT INC.
200 Buell Road, Akron, New York

A UNIT OF HOUDAILLE INDUSTRIES INC

In Canada: Strippit Tool & Machine Company, Brampton, Ontario

Free Literature

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for applications in the field of electro-mechanics, instrument manufacture, ordnance, optics, and fine mechanics in general. One semi-skilled operator can attend two specially arranged machine heads simultaneously. Includes chart on machining time per component in seconds, and main technical characteristics.

TOOLS AND ACCESSORIES

11 CARBIDE TOOLS — *Sandvik Steel, Inc. Coromant Dept, 1702 Nevins Rd, Fair Lawn, N.J.* 52-page catalog 520 is divided into four separate illustrated sections. First three cover Coromant carbide inserts and toolholders, carbide blanks and brazed single point tools, shell end mills, end mills, combination cutters and scrapers. Fourth section explains how to choose and use the various grades to obtain max cutting performance. Complete separate price list included.

12 LEADSCREW TAPPING UNIT — *Procunier Safety Chuck Co, 18 S Clinton St, Chicago, Ill.* Illustrated circular presents design details, specifications, operating instructions, and available accessories. Pushbutton feature permits use in six different ways: for complete cycle or jog, automatic or "switch in fixture," and with pedal attachment for full cycle or jog. Unit taps consistently uniform gage fits in pitches from 20 to 96.

13 GRINDING WHEELS — *Chicago Wheel & Manufacturing Co, 1101 W Monroe St, Chicago 7, Ill.* 12-page illustrated catalog 7525 gives data on complete range of sizes and shapes, with prices. Includes vitrified, resinoid, and rubber bonds in cutoff, straight, recessed, and plate-mounted wheels. Recommended applications are given. Included in the line are Flex and BR (Break Resistant) wheels for portable grinding, weld and metal fabrication, finishing, portable cement grinding, notching and plastic grooving.

14 INDUSTRIAL DIAMOND TOOLS — *A Landau Co, 247 S Ninth St, Philadelphia 7, Penna.* 20-page catalog illustrates and describes single point diamond dressers for straight dressing and for radius; application of the various types is discussed including cone point and chisel point; sliver

"I can't type or take short-hand, but I'm pretty good at cutting down male absenteeism."

It's NEW from DoALL

MORE USEFUL DIMENSIONS WITH FEWER GAGE BLOCKS

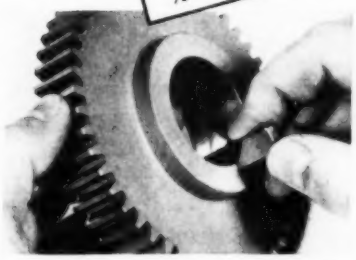
Only set 55-R offers decimal dimensions in .001" increments from .020", in .0001" increments from .100", and fractional dimensions by 1/64 increments from 1/64".

Dimensions	38-Pc. Set	83-Pc. Set	55-Pc. Set
.028" snap ring	No	No	Yes
.046" snap ring	No	No	Yes
1/16" keyway	No	No	Yes
.068" snap ring	No	No	Yes
.086" snap ring	No	No	Yes
3/32" keyway	No	No	Yes
1/8" keyway	No	Yes	Yes

After 53 years—a gage block set for the shop

NEW 55-R SET PROVIDES WIDELY SPECIFIED DECIMAL AND FRACTIONAL DIMENSIONS NOT AVAILABLE IN TRADITIONAL SETS.

Selected by shop men, tested by shop use and checked by a pool of diversified industries, set No. 55-R is the first basic departure from the 81 piece inch series gage block set introduced 53 years ago. Now you can make common fractional dimensions and many others with just one or two blocks instead of the five or six from traditional sets. Greatly reduces time-consuming job of selecting, cleaning and wringing.



Keyway slot in gear simply and easily checked with single fractional block.

One block from .010" series solves problem of checking O-ring groove on this shaft.

Saves you money, too!

The modest price of a 55-R set makes a worthwhile saving over the cost of larger sets. The life of a set of gage blocks is lengthened since fewer blocks are required to make up common dimensions. It is practical to assign a set to each of your toolmakers or machinists to eliminate time waste created by a group working from the same set. Call your local DoALL sales-service store for further information and literature, or write.

AVAILABLE IN THREE GRADES		
AA Grade	+.000002" −.000002"	—$490.00
A+ Grade	+.000004" −.000002"	—$340.00
Shop Blocks	+.000006" −.000002"	—$240.00

GAGE BLOCK SET NO. 55-R			
.010"	(single block)	—	.010" series
.020" through .029"	(10 blocks)	—	.001" series
.1001" through .1009"	(9 blocks)	—	.0001" series
.101" through .109"	(9 blocks)	—	.001" series
.110" through .190"	(9 blocks)	—	.010" series
.100" through .400"	(4 blocks)	—	.100" series
1.000", 2.000", 3.000"	(3 blocks)	—	1.000" series
1/64", 1/32", 3/64", 1/16", 1/8", 1/4", 1/2", 3/4"	(8 blocks)	—	Fract. series
.050" or .100" Steel or carbide wear blocks optional			

GB-30

The DoALL Company, Des Plaines, Illinois

SIMONDS

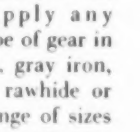
INDUSTRIAL CUT GEARS

LARGE OR SMALL HEAT TREATED OR PLAIN

SIMONDS has over 60 years' experience in cutting quality industrial gears. We can supply any type of gear in cast or forged steel, gray iron, bronze, Meehanite, rawhide or bakelite in a full range of sizes adaptable to the material. Also heat-treated, case or flame hardened gears of carbon or alloy steel. Send us your requirements for quotation.

Custom

GEAR CUTTING



SIMONDS' facilities can produce any type of custom gear from your blanks if you prefer. Same quality . . . same prompt service.

QUALITY GEARS FOR OVER 65 YEARS

SPUR GEARS
BEVEL GEARS
MITRE GEARS
WORMS WORM GEARS
RACKS PINIONS

Also stock carrying distributors of Ramsey Silent Chain Drives and Couplings; and industrial V-belts.

SIMONDS GEARS

THE SIMONDS GEAR & MFG. CO.

LIBERTY at 25TH PITTSBURGH 22, PA.

Free Literature

To order any of these bulletins, circle corresponding number, inside back cover.

point for concave radius dressing; phonopoint for extremely fine, intricate work; side mount for dressing a concave radius, and pantograph dressers for highly specialized contour dressing. Additional products described include hardness testing diamonds, diamond scribers, layered multiple point diamond dressers, diamond powder, wheels and hones.

15 BASIC JIGS AND FIXTURES — *Standard Parts Co, 1040 Broadway, Bedford, Ohio.* 24 x 18-in. catalog includes 70 full size tracing templets, removable and printed in red ink. Templets are indexed; parts numbers and other data is included to facilitate ordering. Illustrated are seven sizes of mill fixture bases and gang fixture bases; seven T angle plates; 47 each aluminum Tumble box jigs and cast iron box jigs; nine heavy-duty box jigs.

16 ALL - ELECTRIC PRODUCTION TOOLS—*Black & Webster, Inc, 445 Watertown St, Newton 58, Mass.* 12-page catalog describes and illustrates complete line of solenoid-operated impact hammers, punches, stakers, and Geneva action indexing tables. Section included on custom engineered automatic equipment.

17 PNEUMATIC COMPARATOR GAGES—*Moore Products Co, H & Lycoming Sts, Philadelphia 24, Penna.* 22-page catalog 8008 presents illustrated descriptions of a new line of air gages for dimensional measurement and a series of automation building blocks for size control systems. Covers newly standardized purchasing data on pneumatic plugs, rings, and gaging cartridges including the Moore Hardcoat (anodized aluminum) Plug and the L-Matic (low-force) Cartridge.

18 SOFT BLANK CHUCK JAWS — *Gahr Machine Co, 19199 St Clair Ave, Cleveland 19, Ohio.* 6-page brochure contains specifications and data on units for all makes of chucks including air, hand or power-operated geared-scroll, two and four-jaw independent, and combination chucks. Booklet is arranged to show interchangeability of jaws between different makes and models of chucks, and to simplify ordering. Units are made in two different heights and in both the standard short-jaw and long-jaw types.

19 INSERT AND POWER BITS — *Zephyr Manufacturing Co, 901 Hindry Ave, Inglewood, Calif.* 8-page catalog 12-C discusses double forging process used in manufacture of Phillips and Frearson insert and power bits for production screwdriving in industrial assembly operations. Lists point and shank dimensions for 148 standard stock bits.

20 POWER HACKSAW BLADE TENSIONING CHART—*E H Wachs Co, 1505 N Dayton St, Chicago 22, Ill.* Chart provides data on Counted Turn Method for applying proper tension to Wachs Guillotine power blades when used on various makes of hacksaw machines. Procedure is tabulated for tensioning blades when used on Marvel, Peerless, and Racine machines. Blade widths covered include 1, 1¼, 1½, 1¾, and 2 in.

21 PORTABLE PNEUMATIC GRINDERS—*Thomas C Wilson, Inc, 21-11 44th Ave, Long Island City 1, NY.* 12-page illustrated catalog PT-58 provides data on recently introduced line that includes both powerful horizontal grinders and high-speed die grinders. First category covers four models, two of which have speed of 60,000 rpm and two 40,000 rpm. Horizontal grinders are available in various sizes and models with speeds from 3100 to 12,000 rpm. Selection tables are provided for 4, 6, and 8-inch heavy-duty models and for 8-in. extra-heavy-duty units. Auxiliary equipment illustrated and described.

22 COORDINATE COMPARATOR — *Gaertner Scientific Corp, 1201 Wrightwood Ave, Chicago 14, Ill.* Bulletin 169-58 provides information on the M1229. Model is designed for precise measurement of records on photographic films or plates, such as star photographs, spectrograms, X-ray plates, and charged particle tracks. It can also be used as an inspection and measuring instrument for tools, dies, and small mechanical parts. It reads to 0.001 mm and 0.01° of arc.

HEAT TREATING AND WELDING

23 SIGMA WELDING—*Linde Co, Div of Union Carbide Corp, 30 E 42nd St, New York 17, NY.* 48-page instruction booklet F-7825 has been revised to include latest recommendations for Sigma welding on all commercially available metals. Includes current, gas flow, joint design, and filler metal recommended for various materials. New wires now available are included in a section on filler metal.

24 WELDING EQUIPMENT AND INDUSTRIAL REGULATORS—*Modern Engineering Co, 5411 Pine Blvd, St Louis 3, Mo.* 24-page brochure, illustrated with cross-section drawings, evaluates 50 design features found in oxy-acetylene welding and cutting equipment and industrial regulators produced by 19 leading manufacturers.

25 SOLDERING IRON TIPS—*Hexacon Electric Co, 135 W Clay Ave, Roselle Park, NJ.* Illustrated form 601 contains information on Long-Life soldering iron tips No. 601 (superseding No. 600). Data given on 81 new shapes and sizes, a total of 124. Included are plug tips from 1/16 to 1¼-in. dia and screw tips from 7/16 to 1¾-in. dia. Variety of tip shapes are pictured and complete dimensions are given, as well as advice on use and care, and list prices. Detailed specifications provided on the XTRADUR Tips which give up to 20 times longer life than copper tips.

PARTS AND MATERIALS

26 V-BELT DRIVES—*Dodge Manufacturing Corp, Mishawaka, Ind.* 44-page bulletin A-695 describes new line that is smaller, costs less, weighs less than conventional V-belt drives. Illustrated with photos and engineering drawings, text explains construction features of new Dyna-V sheaves and V-belts that enable them to deliver up to three times as much hp in a given space. Tabular data included on pre-engineered drives, hp capacities, belt speeds, center distances, sheave diameters.

(continued on page 207)

"You wouldn't dare fire me!"

Lincoln

WELDYNAMICS

NEWS ABOUT ARC WELDING AT WORK CUTTING COSTS

AEROGLIDE TRIMS WELDING COSTS 1/3 ...IMPROVES PRODUCT QUALITY

Structural parts are welded faster and easier with Jetweld.

Like many other manufacturers, Aeroglide Corporation of Raleigh, North Carolina, found themselves caught in a price-cost squeeze last year.

Aeroglide is one of the largest manufacturers of produce handling equipment and grain driers. All the equipment they build is welded and much of the welding is on sheet metal. Their biggest cost problem involved the sheet metal welds. Burn-through and spatter were eating up shop time and profits.

John Wyatt, Aeroglide's Shop Superintendent, "Our whole shop is more efficient because of improved welding methods."

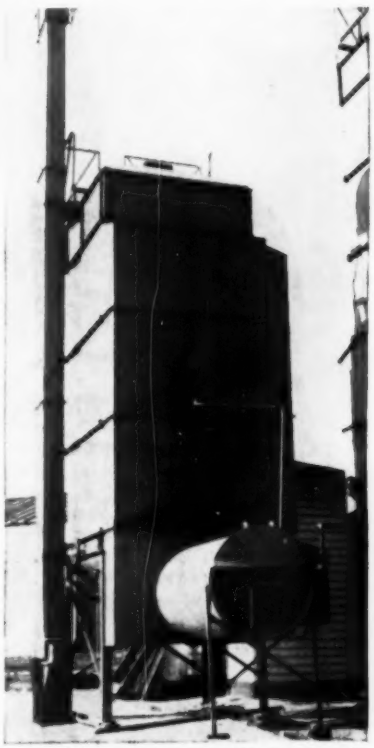
John P. Wyatt, Jr., Aeroglide's shop superintendent and James F. Kelly, President, decided to seek outside help. They invited Kirk Sterling, a welding engineer with Lincoln's Charlotte, N.C. office to help them make a survey of Aeroglide's welding operations.

Working closely with Mr. Wyatt, Sterling made a careful analysis of their welding jobs. The burn-through and cleaning problems were solved with a switch to Fleetweld 37 electrodes which are specially designed for sheet metal welds. Greater production efficiency on heavier structural members was achieved with iron-powder Jetweld electrodes.

Mr. Sterling also conducted a five-day welding clinic which was voluntarily attended by Aeroglide's weldors and shop supervisors. Higher shop efficiency resulted from a better understanding of welding procedures as a result of the clinic.

The total effect—a 33% cut in welding costs.

Jim Kelly, Aeroglide's youthful president, commented, "The Lincoln people have done us a great service. Big industries can go to their suppliers and demand the products they need. Companies like ours depend on our suppliers to show us how to get the most out of what's available. Lincoln has helped us build a better product . . . and made a stronger Lincoln customer.



Aeroglide grain dryers, easier to assemble, sturdier and more efficient with welded construction.

The LINCOLN ELECTRIC CO.
Dept. 2030, Cleveland 17, Ohio
The World's Largest Manufacturer of Arc Welding Equipment

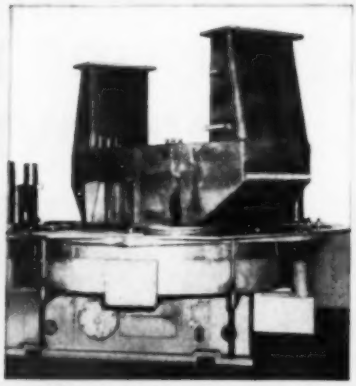
CIRCLE 319 READER SERVICE CARD

A LAPMASTER CAN MEAN BIG SAVINGS...A BETTER PRODUCT

here are more examples of how:

HIGH PRODUCTION RUNS or small lots—both turned out with *consistent* accuracy on a Lapmaster. Day-in-day-out production rates range from a few pieces to thousands per day.

FLATNESS OF .0000116" or less with a micro-inch finish of 2 to 3 RMS is everyday work for a Lapmaster. Uniform accuracy maintained piece-after-piece because conditioning rings automatically keep lap plate flat.



4920 LB. PARTS can be handled—as well as small ⅛" dia. pieces. This 84" dia. weldment for a radar tracking antenna was lapped to a flatness and parallelity within ± .00005" on a Lapmaster Model 84.

TALL and SMALL PARTS AT THE SAME TIME. No expensive fixturing required... in most Lapmaster applications only inexpensive masonite or micarta work holders are necessary. Eliminates danger of stresses and warpage usually caused by clamping during grinding.

EXTERNAL and INTERNAL LAPPING IN ONE OPERATION. Versatility of the Lapmaster is demonstrated in this lapping operation on R. R. air brake parts. Reciprocating mechanism runs small lapping block in and out of work while other parts are being lapped on plate.

SHAPE OR FORM NO PROBLEM. Special lap plate and work holder permit lapping of swing check valve. Other simple attachments and holding devices can be furnished to facilitate lapping of "hard-to-handle" or extremely large parts.

Lapmaster®

...THE MACHINE THAT PUT PRECISION LAPPING ON A PRODUCTION BASIS

WRITE FOR THE COMPLETE LAPMASTER STORY

Write for bulletins describing the Lapmaster line and chart on measuring flatness.

A product of

Crane Packing Company

6436 OAKTON STREET • MORTON GROVE, ILLINOIS (Chicago Suburb)

In Canada: Crane Packing Company, Ltd., Hamilton, Ont.

Free Literature

To order any of these bulletins, circle corresponding number, inside back cover.

27 HEAT-RESISTING ALLOY — *Latrobe Steel Co, Latrobe, Penna.* 8-page technical bulletin 1257 contains information on Dynaflex, an air-hardening specialty steel that possesses exceptionally high strength at elevated temperatures. Material is said to resist softening upon continued exposure to temperatures up to 1000 F, and to provide high toughness and ductility at tensile strength levels up to 300,000 psi. Data provided on physical and mechanical properties, heat treating recommendations, plus experimental working charts and graphs.

28 UNIVERSAL WORM GEAR SPEED REDUCERS—*Link-Belt Co, Prudential Plaza, Chicago 1, Ill.* 8-page bulletin 2724 provides information on new type that has a higher capacity and external fins for cooling. Illustrates and gives dimensions and weights for three types of mountings: worm shaft below gear, on top of gear, and output shaft vertical. Includes selection procedures for proper applications; tabular data on service factors, load classes, input hp ratings, overhung load ratings, and thrust load ratings.

29 CENTER BONDED MOUNTINGS—*Lord Manufacturing Co, 1635 W 12th St, Erie, Penna.* 4-page bulletin 712 illustrates and describes vibration isolation and heavy shock absorption features of units that are adaptable to base or frame-mounted assemblies. Includes data on installation, performance, and specifications of both compression-type and shear-type mountings.

● MOTOR CONTROLS SELECTOR CHART — *Arrow-Hart & Hegeman Electric Co, Industrial Control Div, 103 Hawthorn St, Hartford 6, Conn.* Illustrated Quick Selector Chart, hole-punched at top for wall hanging, covers controls for use with single and polyphase, 1800 rpm, ac squirrel cage motors. Includes data on ratings, sizes, features, catalog numbers, and ordering instructions. Last two pages contain complete listing of standard heater tables. Request direct on company letterhead.

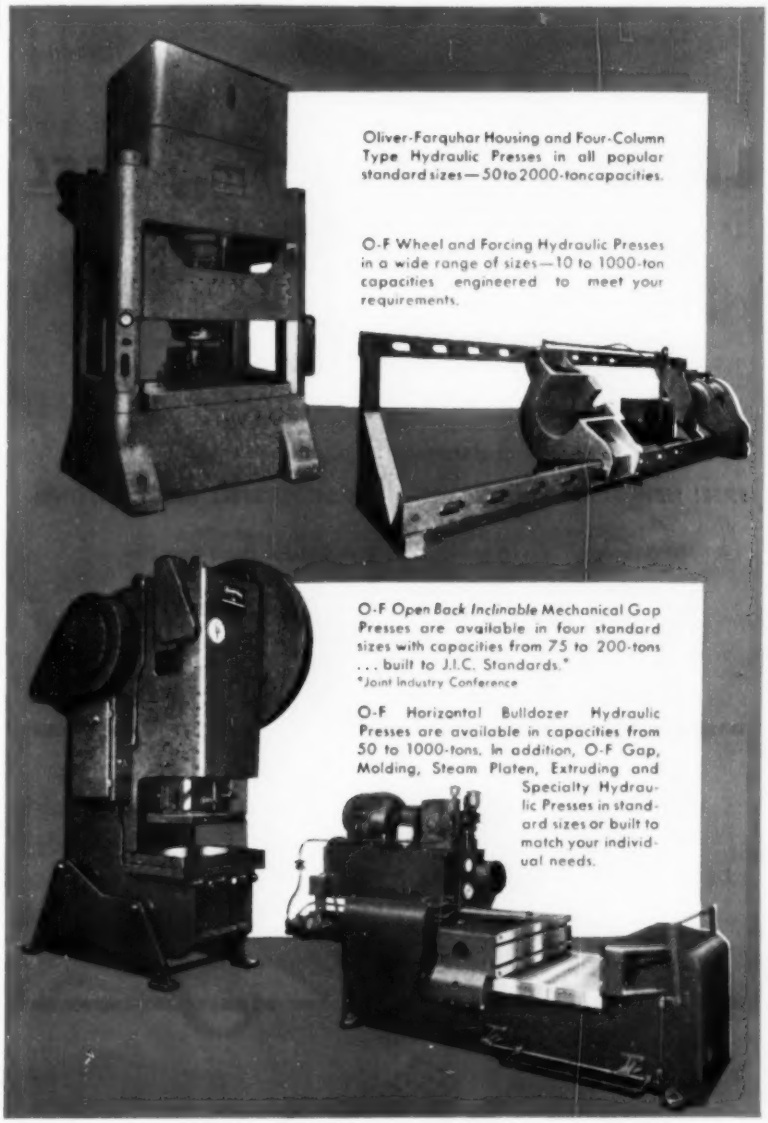
30 VARIABLE-SPEED DRIVES — *Reeves Pulley Co, Div of Reliance Electric & Engineering Co, Columbus, Ind.* 8-page bulletin G-5812 describes complete line that provides precise, infinitely adjustable output speeds from a constant rpm

"I thought there was something funny about the new warehouse watch dog!"

Hydraulic and Mechanical

OLIVER Farquhar PRESSES

. . . designed and built with individual precision to give you maximum operating efficiency!



Oliver-Farquhar Housing and Four-Column Type Hydraulic Presses in all popular standard sizes—50 to 2000-ton capacities.

O-F Wheel and Forcing Hydraulic Presses in a wide range of sizes—10 to 1000-ton capacities engineered to meet your requirements.

O-F *Open Back Inclinable* Mechanical Gap Presses are available in four standard sizes with capacities from 75 to 200-tons . . . built to J.I.C. Standards.*

*Joint Industry Conference

O-F Horizontal Bulldozer Hydraulic Presses are available in capacities from 50 to 1000-tons. In addition, O-F Gap, Molding, Steam Platen, Extruding and Specialty Hydraulic Presses in standard sizes or built to match your individual needs.

Write, wire or phone today for the facts on Oliver-Farquhar Presses made with individual precision to give you maximum operating efficiency. Our engineers will be glad to submit recommendations covering our complete line of presses.

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CIRCLE 321 READER SERCICE CARD

RAY RIVERS, 33 years of service, LENOX chief test man

LENOX *HIGH SPEED STEEL*

band saw blades

Cut faster . . . take greater feeds . . . last longer than conventional sawing methods, the new *LENOX High Speed Steel* Band Saw Blades assure greater production rates. Recommended specifically for special tilt-spindle steel band saw machines, these new Lenox blades have performed successfully on some regular band saw machines. Available in standard and hook tooth design.

FREE! NEW HELPFUL HINTS ON HIGH SPEED STEEL BAND CUTTING

New illustrative product data sheet offers the complete story of Lenox High Speed Steel Band Saw Blades with helpful suggestions on cutting. Write today for Data Sheet No. 1202.

For help with your specific cutting requirements, a high speed steel band saw specialist direct from factory is ready to serve you. Please write or call for immediate attention.

IMPROVED!

LENOX
THE TOOLS IN THE RED BOX

AMERICAN SAW & MFG. COMPANY
SPRINGFIELD, MASSACHUSETTS • U.S.A.

Free Literature

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motor source operating from standard in-plant ac circuits. Covers mechanical construction features, condensed drive specifications, available speed variations, and accessories for the Vari-Speed Motodrive, motor pulley, and variable-speed transmission.

31 "ROLE OF MOLYBDENUM IN ABRASION RESISTANT MATERIALS"—*Climax Molybdenum Co, 500 Fifth Ave, New York 36, NY.* 36-page booklet describes in detail the three general types of wear—gouging, grinding, and scratching. Proper selection of material for particular types and conditions of wear is discussed. Section on how to produce abrasion resistant parts with four specific alloys is included as well as illustrations of end uses of the materials, and mechanical property data.

32 DUCTILE IRON — *American Cast Iron Pipe Co, PO Box 2603, Birmingham 2, Ala.* 36-page illustrated catalog describing complete line of products available in sizes 2 to 48-in. diameters provides technical information including grades, specifications, dimensions and weights, uses and applications.

33 MACHINABLE CEMENTED CARBIDE—*Sintercast Corp of America, 1½ Woodworth Ave, Yonkers, NY.* Technical data sheet (bulletin 12) supplies information on physical properties and metallurgical characteristics of Ferro-Tic.

34 VALVES—*Barksdale Valves, 5125 Alcoa Ave, Los Angeles 58, Calif.* 20-page illustrated catalog 59-60, sectionalized according to type of medium used (oil, water, air), covers manual, foot-operated, and solenoid models. Over-all pressure range is from vacuum to 10,000 psi. Typical flow patterns, and illustrations of specific valves, port sizes, ordering data, and numbers included.

35 HEAVY PRESS ALUMINUM EXTRUSIONS — *Harvey Aluminum, 19200 S Western Ave, Torrance, Calif.* 16-page brochure discusses designing for

"We hate to fire you, Higgins . . . fine workman . . . excellent production record . . . good disposition . . . but . . . well . . . frankly, it's your breath."

FOR ACCURATE LOCATING USE UNIVERSAL LOCATING PINS

Universal Locating Pins assure quick, accurate locating throughout even the longest production runs. They're hardened and ground to extremely close tolerances . . . precision made to give long service life for much less than the cost of ordinary tool-room pins.

Press fit, threaded or lock-screw types, round or relieved, are stocked in all standard sizes for immediate delivery. Write for catalog detailing locating pins plus other Universal production tools.

Relieved Press-Fit Pin

Threaded Pin

Lock Screw Pin

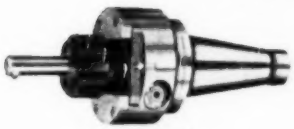
212

OTHER PRECISION-BUILT COST SAVING UNIVERSAL PRODUCTION TOOLS

Floating Chuck

Standard Collet Chuck

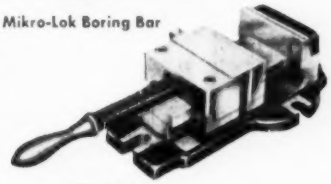
Mikro-Lok Boring Bar



Boring Chuck

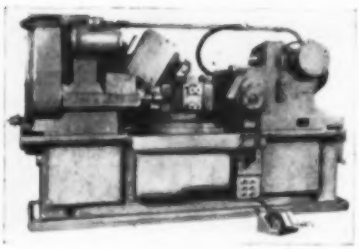
"Kwik-Switch" Tool Holder

Standard Drill Bushing



Wedge-Lock Production Vise

UNIVERSAL ENGINEERING COMPANY, FRANKENMUTH 1, MICHIGAN



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CHUCKING
MACHINE

When any of the various functions for which this machine is designed are performed on it, no further machining is required. The job is finished.

The basic "1-2-3" method . . . exclusive with Goss & De Leeuw . . . provides for gripping work in the chuck and machining all ends either simultaneously or in sequence. By eliminating several handlings and set-ups, the "1-2-3" method produces finished pieces at a fraction of the time and cost ordinarily required.

Send samples of your work for time estimates. Ask for illustrated literature containing detailed information.

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MACHINE COMPANY, KENSINGTON, CONN., U.S.A.

CIRCLE 324 READER SERVICE CARD

Free Literature

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these extrusions including types of sections producible and standard manufacturing limits for solid shapes, hollow shapes, panels, and tube.

36 PREVENTING COLUMN FAILURES IN HYDRAULIC CYLINDERS—*Miller Fluid Power Division, 2040 N Hawthorne Ave, Melrose Park, Ill.* Literature includes illustrations, formulas, and explanatory matter for quickly determining the column strength limitations of a wide range of piston rod diameters of various lengths when used in horizontally and vertically mounted cylinders of commonly used mounting styles. Use of stop tubes and oversize rods is also discussed.

MISCELLANEOUS

37 FREE TEST CUTTING SERVICE—*DoAll Co, Des Plaines, Ill.* 11-page illustrated brochure describes two new demonstration-test centers that will perform test cutting of actual workpieces submitted by customers to permit an accurate appraisal of cost per cut, tool life, and production rates before purchase of a DoAll machine tool or to gage the efficiency of customer's present equipment.

38 INDEX OF INSTRUMENTATION LITERATURE — *Minneapolis-Honeywell Regulator Co, Industrial Div, Wayne & Windrim Avenues, Philadelphia 44, Penna.* 24-page bulletin G2-1a lists available Industrial and Valve Division product, technological, and application literature. Includes listings of product catalogs, technical bulletins, instrumentation data sheets, magazine articles, educational aids, and other Honeywell services.

39 MACHINERY REBUILDING—*Gahr Machine Rebuilding Co, 19199 St Clair Ave, Cleveland 19, Ohio.* 4-page brochure outlines ten ways to tell when a machine tool has lost its original accuracy and should be rebuilt. Among machines company manufacturers are lathes, turret lathes, screw machines, boring mills, and milling machines.

40 DEEP HOLE DRILLING—*20th Century Machine Co, 6070 E 18 Mile Rd, Utica, Mich.* 4-page brochure describes facilities for drilling deep holes of any diameter or depth in all types of materials and hardnesses. Typical jobs illustrated; available machinery listed.

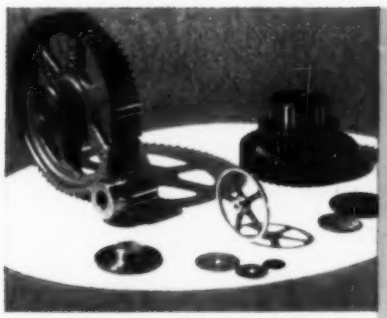
"Talk about obsolete equipment! He retired years ago but he still comes in to visit the machine he began with."

"Why slow up the job with special gears?"

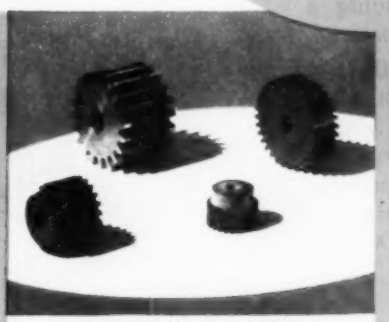
when you can select what you need from over 2000 standardized

BOSTON GEARS

FROM STOCK
OFF-THE-SHELF
at factory prices

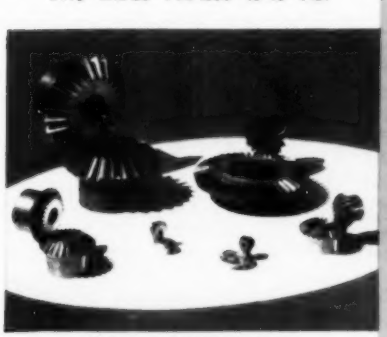


SPUR GEARS — STEEL, IRON, BRASS
14½° and 20° P.A. .208" to 40" P.D.



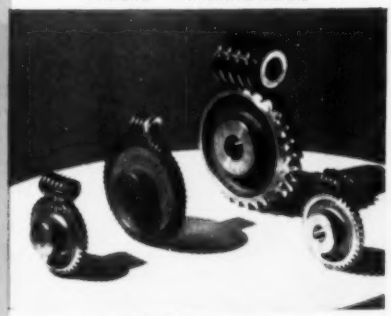
NON-METALLIC SPUR GEARS
14½° and 20° P.A. .938" to 6.667" P.D.

RACK • PINION WIRE
Steel and Brass 14½° and 20° P.A.
PINIONS • INTERNAL GEARS



BEVEL and MITER GEARS
Steel, Iron, and Brass 20° P.A.
.312" to 14" P.D.

STEEL SPIRAL MITERS 1" to 5" P.D.
HELICAL GEARS
Steel and Bronze .333" to 6" P.D.



WORM GEARS Bronze and Iron
.417" to 18" P.D. **WORMS** .333" to 4" P.D.
Soft Steel and hardened and ground steel

9496
STANDARDIZED TRANSMISSION PRODUCTS

Stock Gears
Sprockets and Chain
Speed Reducers
Bearings • Couplings
Shaft Supports
Pulleys

Take a good look through the BOSTON Gear catalog. You'll find standardized types and sizes to fit most of today's transmission needs. Why pay more (and wait) for gears made to order? Design around BOSTON Gear. It saves time and money in planning, in purchasing, in production . . . and you simplify servicing problems. Boston Gear Works, 60 Hayward Street, Quincy, Mass.

CALL YOUR
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DISTRIBUTOR

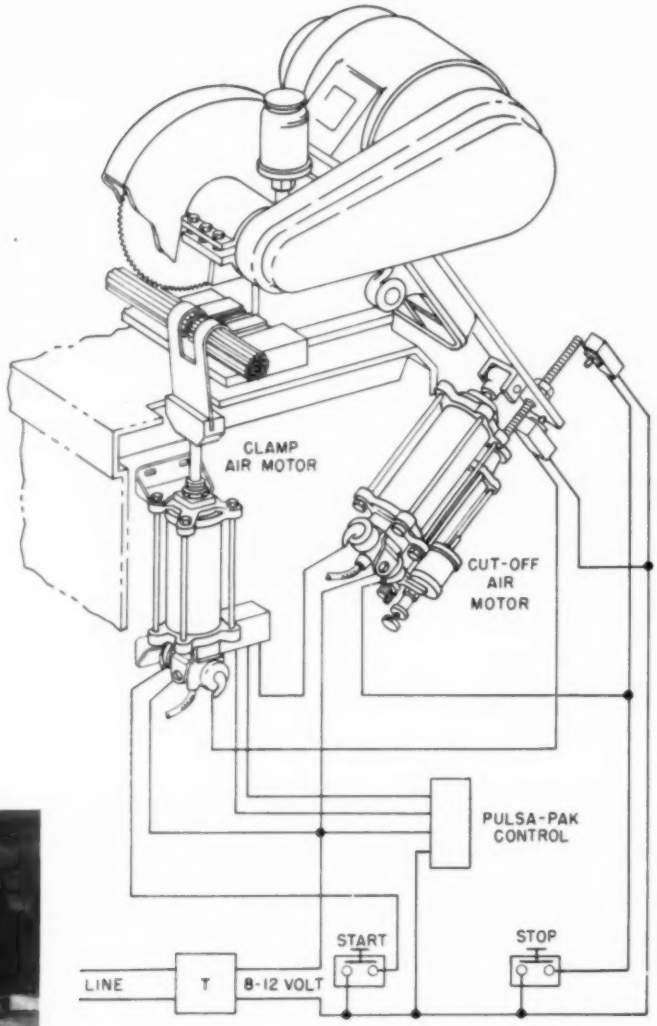
— STANDARDIZATION PAYS —®

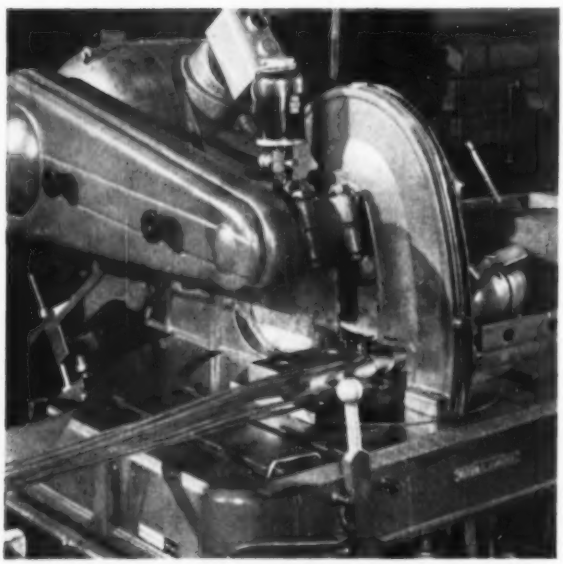
HOW TO MAKE A CUT-OFF SAW PRODUCE MORE AT LESS COST

Shown at the right is a SPOT-A-MATION IDEA used in many plants. Almost invariably it has meant cost savings of 50% or more—has improved product quality, lengthened saw life, lessened worker fatigue.

Two Bellows Air Motors are used. One, hydraulically controlled, feeds the saw through the work. The second clamps the work in position. The two Air Motors are electrically interlocked. The cut-off saw can be made completely automatic by adding a third Air Motor to feed the material.

This is another typical way Bellows Air Motors are used to "Spot Modernize" existing equipment. Almost any hand-fed, or hand-controlled machine can be made to produce more, at less cost, with versatile Bellows "Controlled-Air-Power" Devices.





Typical application of this SPOT-A-MATION IDEA in the plant of Milwaukee Gas Specialties where gas tubing is cut to length. Here costs were cut better than 50% and cost of rejected material reduced 20%.

THIS SPOT-A-MATION IDEA FILE IS YOURS ON REQUEST

Contains drawings, circuit diagrams, equipment list, and full details to enable you to convert existing equipment to lower cost operation. Write for it today. No obligation.

Address Dept. AM359, The Bellows Co., Akron 9, Ohio.

The Bellows Co.

DIVISION OF INTERNATIONAL BASIC ECONOMY CORPORATION (IBEC)

AKRON 9, OHIO

1284-B

OTHER INDUSTRIAL DIVISIONS OF IBEC: Sinclair-Collins Valve Co., Valvair, Akron, Ohio • V. D. Anderson Co., Cleveland, Ohio

Alfred T Blackburn (left), works manager of Cincinnati Milling Machine Co, has been elected vice president in charge of manufacturing. **Clyde Eby**, assistant works manager, succeeds Mr Blackburn

Carl J Demrick has been named president of Chrysler Corp's Amplex Division. He was formerly manufacturing vice president of Plymouth Division

NAMES IN THE NEWS...

Beauchamp E Smith, general manager of Allis-Chalmers Hydraulic Division, York, Penna, has been elected a vice president of the company. Mr Smith served as president for 17 years of the S Morgan Smith Co which recently became the York Works of Allis-Chalmers.

Pierce T Angell, engineering manager of the Tapco Group of Thompson Ramo Wooldridge Inc, has been elected a vice president of the company. Also named vice presidents: **Robert E Cummings**, manager of the Valve Division; **William M Jones**, manager of the Commercial Electronics Group; and **Carl L Kahlert**, manager of the Replacement Division.

Donald E Smiley has been named president of Pico Precision Products, Los Angeles, subsidiary of Pendleton Tool Industries. Formerly vice president, manufacturing, of Weber Showcase and Fixture Co of LA, he replaces **Roger H Stokes** who has resigned.

G W Trichel, formerly president of Chrysler Corp's Amplex Division, has been named military advisor to the group vice president, defense and special products. **William C Cawthon** is the new plant manager at the Plymouth final assembly and body plants. Formerly plant manager at Dodge, he succeeds **C J Demrick** (see above). **Joseph B Neal**, production manager at Dodge, takes over Mr Cawthon's former post. **Harry R Bentley**, plant manager of the Trenton Engine plant, has been appointed manager of the Mound Road Engine plant. **Vincent P Masi**, manufacturing manager at Trenton, succeeds Mr Bentley.

Irving C Maust has been named manager, industrial and machine tool operations, of RCA. Headquartered at the Detroit manufacturing center, he will be responsible for development and marketing of automation equipment and systems for industry.

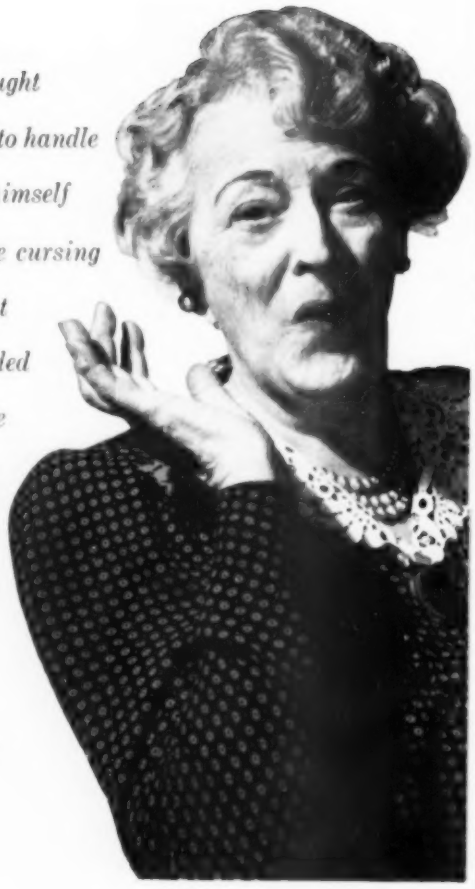
D F Griffin, formerly associated with Vanadium-Alloys Steel Co, has been named chief metallurgist of Landis Machine Co, Waynesboro, Pa.

Howard Carson has been elected vice president of Cadillac Gage Co, an Ex-Cell-O Corp subsidiary, and general manager of the Costa Mesa operation. He has been in charge of the West Coast Division since February 1957.

(continued on next page)

Jacob J Jaeger (left), vice president in charge of engineering, Pratt & Whitney Co, West Hartford, Conn, has been named executive vice president of the company. **Edward J Shages** (center), vice president and manager of the Cutting Tool and Gage Division, has been appointed vice president in charge of manufacturing for all operations. **Henry J Fredericks**, treasurer-controller, has been named a vice president

I'm being courted again...



You'd have thought Herbert actually had to handle those dirty old gears himself the way he'd come home cursing and mumbling about "rejects" and "added costs". But this is the third night this week he's taken me out for dinner! I'd certainly like to meet that CINCINNATI person!

Whether it's custom gears or custom gear boxes, you'll be pleased with CINCINNATI quality, price and delivery. Shaved gears to 39" diameter, tooth grinding capacity to 25". Write for brochure.

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NAMES IN THE NEWS...

Ernest Swain has been elected president and general manager of Dixie Tool Industries, Inc, Bridgeport, Mich. **Milo Shaner** has been named vice president and assistant general manager.

George N Popham, Gorham Tool Co, has been elected president of the Cutting Tool Manufacturers Association. **Kenneth R Beardslee** of the Metallurgical Products Division of General Electric, has been elected vice president.

H E Robison has been elected president and treasurer of Wheel Trueing Co, Detroit, succeeding **H B Wallace,** founder and president of the company, who becomes chairman of the board. Mr. Robison has been affiliated with the company since 1919 and has been treasurer since 1932.

Robert M Snyder has been appointed general manager of Dis-Die Steel, Inc, Detroit. He was formerly associated with Crucible Steel Co.

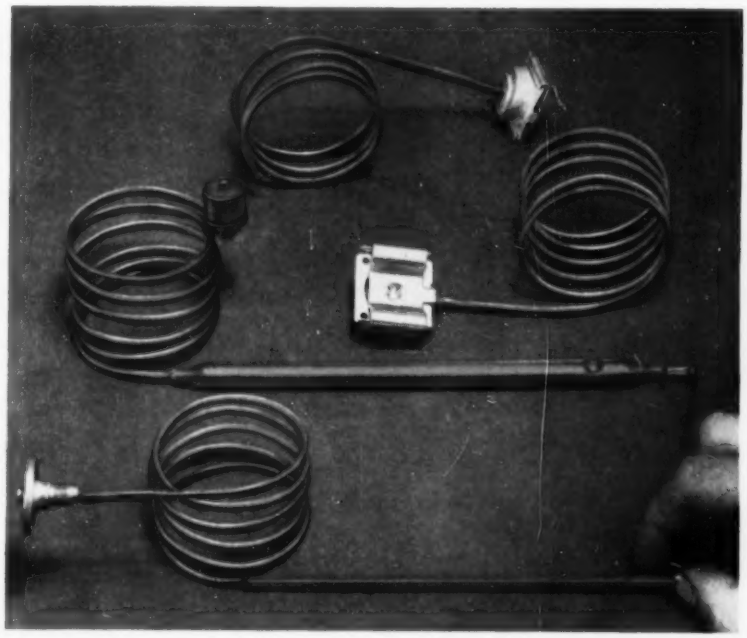
Frederick O Bischoff has joined Potter Instrument Co, Plainview, NY, as production manager. Prior to his appointment he was plant manager and production supervisor at Bulova Watch Co, Woodside, NY.

Joseph A Ackermann has been named sales manager of Elwell-Parker Electric Co, Cleveland. **John A Draxler,** assistant chief engineer, takes over Mr Ackermann's former post as chief engineer.

Carl W Shattuck, first vice president of McKiernan-Terry Corp, Harrison, NJ, has been elected president to succeed **John C Smaltz** who has resigned but will continue as consulting engineer. Company, which designs and manufactures special material handling equipment, has plants at Harrison and Dover, NJ. Mr Shattuck was previously in charge of the Dover facility.

Charles F McKenna, Jr, has been elected president of Johnson & Hoffman Manufacturing Corp, Mineola, Long Island, NY. He succeeds **Jay H Johnson** who has resigned. Mr McKenna was formerly treasurer of J&H, a subsidiary of Superior Tube Co. Company supplies precision stampings and deep-drawn parts, and makes metal mica stampings for electronic applications.

10 TO 15 NEW JOBS a week, each a different application, require a continuous program of evaluating the properties of metals and fabricating costs at Robertshaw-Bridgeport.



In making bellows (left) and temperature sensors (above) to meet ever-changing needs of control, appliance, and industrial equipment manufacturers, Bridgeport Thermostat Div., Robertshaw-Fulton Controls Co., Milford, Conn., averages 10 to 15 new problems a week. Specifications vary widely in dimensions and physical characteristics. Dependable performance over long periods of uninterrupted service is vital—yet costs must be rigidly controlled.

So for quality with maximum economy in fabrication, materials must be matched precisely to the needs of each job. And in this, Robertshaw-Bridgeport looks to its suppliers for creative technical services. For many years, The American Brass Company specialists have been helping to select the correct alloys in phosphor bronze or brass and to meet fabrication problems in the making of bellows—to apply economically precision-made capillary tubing and other small-diameter copper tube in sensor assemblies. Through such services, The American Brass Company is constantly helping metal fabricators across the nation control quality while keeping costs down.

ARE you caught between cost reduction and quality control? Find out if you are buying metal properties you don't need. An Anaconda specialist may be able to suggest a lower cost alloy that fits the requirements of your job more closely. Or he may find that an adjustment of temper or a change in your fabrication methods can cut your costs. The services of Anaconda specialists are available through your American Brass representative. Call him in today, or write: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

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NEW BOOKS...

MATHEMATICS FOR INDUSTRY—*By S E Rusinoff, professor of mechanical engineering, Illinois Institute of Technology. Published by American Technical Society, 850 E 58th St, Chicago, Ill. 563 pages. Price $6.25.*

Once you get beyond the title page, which is almost covered with the author's titles, memberships, and implied qualifications, you'll see that this book is a straightforward and simple approach to mathematics for shop instruction. Nothing fancy; in spite of the ponderous title page, the author went to a good deal of trouble to make the text easy to follow.

The book covers mathematics through trigonometry, logs, slide rules, screw threads, gears, graphs, and inspection and quality-control calculations. In addition, a chapter on "engineering computations" goes easily into the methods of solving strength-of-materials and power problems.

This is good, clear stuff for shop personnel—or anyone, for that matter—because it is concise, which is a problem with many textbooks. It is fairly easy to find a straightforward answer to any question within the range of the text; and it won't take too long to get through accompanying ideas and complications.

The text is quite fundamental, but it would serve as an efficient reference for anyone not usually connected with engineering or shop work to provide quick references, for example, on how thread profiles differ, and for trig and log tables. And as a shop-math book, it should prove unusually useful and easy to learn from.

•

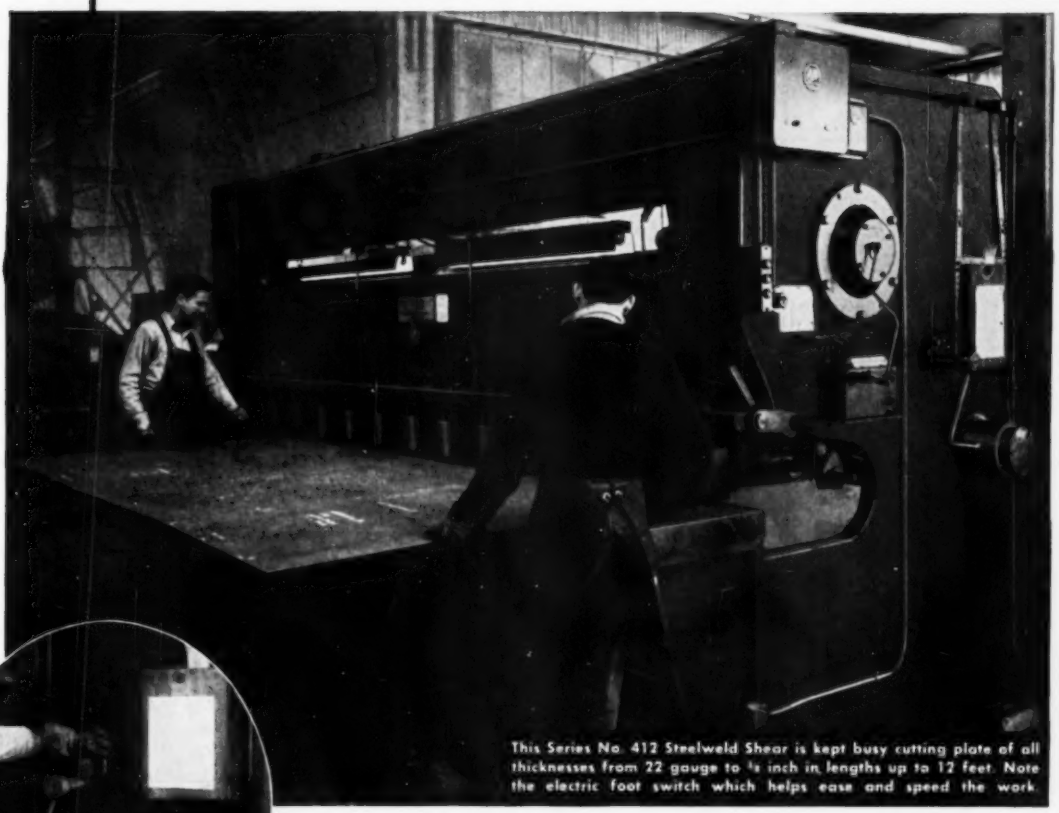
56 GRADED PROBLEMS IN ELEMENTARY SHEET METAL—*By Algot E Anderson, Topeka Public Schools. Published by McKnight & McKnight Publishing Co, Bloomington, Ill. 144 pages. Price $3.80.*

The 56 graded problems are actually 56 short workshop projects that might be taken on by schoolboys in sheet-metal shop classes, or by home-workshop enthusiasts. Each project has a working drawing, a list of materials, and a step-by-step procedure. There are seven divisions; simple cutouts, soldered joints, riveted joints, oblique lines, cylinders, cones, and pyramids.

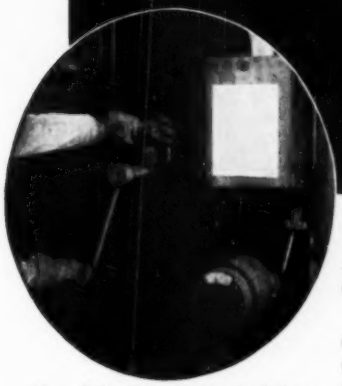
The book has a "boy craftsman"

(Continued on page 219)

KNIVES STAY SHARP LONGER for California Steelweld Shear User



This Series No. 412 Steelweld Shear is kept busy cutting plate of all thicknesses from 22 gauge to ½ inch in lengths up to 12 feet. Note the electric foot switch which helps ease and speed the work.



One of the big reasons why knives stay sharp longer on Steelweld Shears is the simplicity with which knife clearance can be adjusted for every plate thickness. It's merely a matter of turning a hand crank until the gauge pointer is on the proper figure. No bolts to loosen. No need of a feeler gauge.

"It's a shame," said the shop foreman at Stephens-Adamson Mfg. Co., Los Angeles, California, "but since installing our Steelweld Shear the knife-sharpening man has been crying because we have no work for him."

After months of continuous operation, eight hours a day, usually six days a week, inspection of cut pieces indicates the knives are practically as sharp as new. Parts cut have no burrs and are straight and true. Even when the cutting edges of the knives finally become dulled, there are three more cutting edges ready for use as all four corners of each knife are prepared for shearing.

Stephens-Adamson like their Steelweld Shear and are happy over its operation. It plays an important role in the manufacture of screens, elevators and conveyors which are the principal products of this large West-coast plant. In their words, it is "heavy, well built and dependable. We know it is reliable and always ready to handle our work from day to day."

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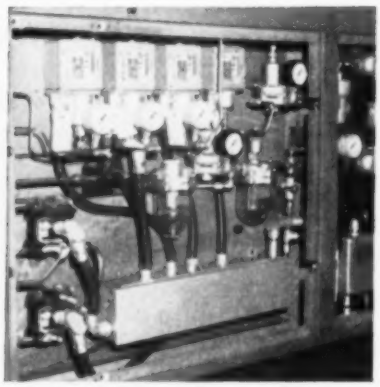
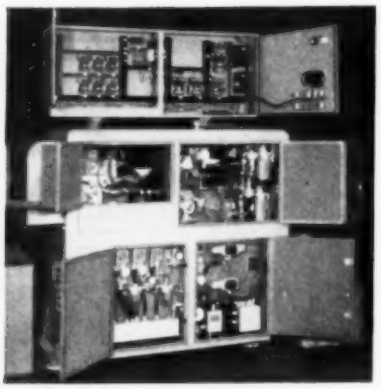
Skinner solenoid valves solve many different cylinder control problems

Application. This Bryant "Centalign" automatic internal grinder is an entirely new concept in precison grinding machinery. Work parts are gravity-fed through chutes and loaded to grind position automatically. Centalign design permits higher, more accurate production at lower cost in the grinding of straight or tapered bores or forms such as ball tracks.



Seven Skinner valves used. Four-way, V9 valves control cylinders actuating work ejector, work interceptor and work loading chute. Others control cylinders for activating a diamond holder for wheel sizing; an oscillator for grinding; and a compensating cylinder to skip wheel dressing action. Still another controls the shop-air supply to the machine.



Adjustable flow features of the four-way valves permit split-second adjustment of cylinder action. And all the valves are small, compact and easy to mount at any angle. Built-in spring returns assure positive closing. Such features enable Bryant to manufacture the Centalign in panels that afford easy access to all pneumatic, hydraulic and electric circuits.

A complete line. There's a Skinner solenoid valve for almost any flow application with a wide variety of media: air, oil, water, inert gases, hydraulic fluids, kerosene and gasoline. Orifice sizes range from $\frac{3}{64}$" to 1". Pressure ratings range from 5 psi to 3000 psi. Explosion-proof models are UL approved for Class 1, Group D and Class 2, Groups F and G.

100,000 variations. The Skinner valves used by Bryant are so versatile in design that standard models can be used for applications normally calling for specials. Skinner solenoid valves are engineered to have a life expectancy of millions of trouble-free cycles.

Quality assured. Electrical tests to UL Standards include resistance check of coils in valve; breakdown check of 2x's rated voltage plus 1,000 volts; heat rise check of continuously energized coil for operation not above 85°C (185°F) rise above room temperature. These tests assure that you can use Skinner solenoid valves with confidence.

Skinner solenoid valves are distributed nationally.

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air about it that should make it suitable for school shops. Material has been selected with care so it follows gradually increasing grade of difficulty.

•

MANUFACTURING PROCESSES: PRODUCTION—*By S E Rusinoff, professor of mechanical engineering, Illinois Institute of Technology. 2nd Edition. Published by American Technical Society, 848 E 58th St, Chicago 37, Illinois. 560 pages. Price $7.25.*

A straightforward account is provided of the basic machining operations with chapters on lathes and milling machines, on drilling, boring, reaming, shaping, slotting, planing, sawing, filing, broaching, gear cutting, and grinding.

Each chapter progresses from a basic description of the process to the variations of the machine, to the tooling and operation. Most of the illustrations have been retained from the 1st edition and the machines are now obsolete, but the principles are still valid.

An introductory chapter goes into some of the basics of metal cutting and near the end is an excellent chapter on inspection, including a basic description of many types of gages.

To wind up the book there are two chapters on "new methods" in metal cutting and chipless production. This is usually hazardous ground in a book because development has a way of outrunning writing and publishing schedules. Despite this problem, the author does rather well in the chapter on metal cutting; not so well on chipless production.

Despite the broad title, this book deals with metal cutting, not metal forming. The final chapter on forming appears without the basic coverage of the subject that should have gone first.

Accepted as a metal-cutting text, it would be extremely useful in an apprentice program or for individual study.

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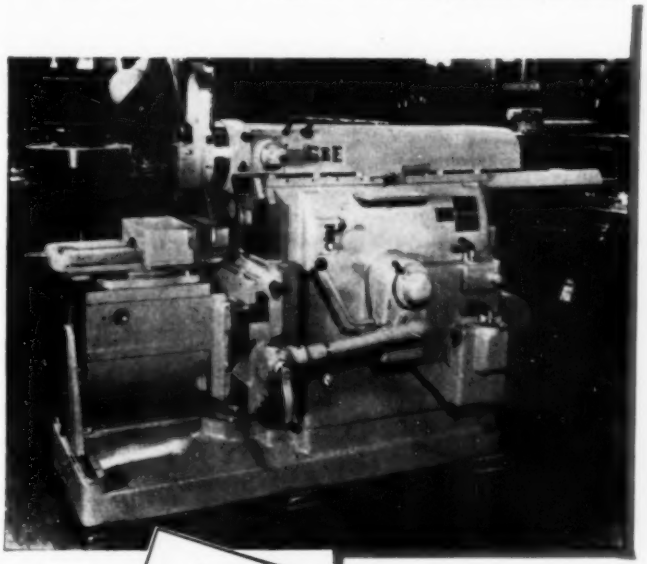

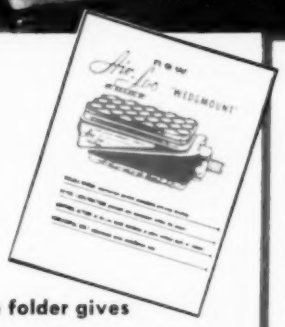

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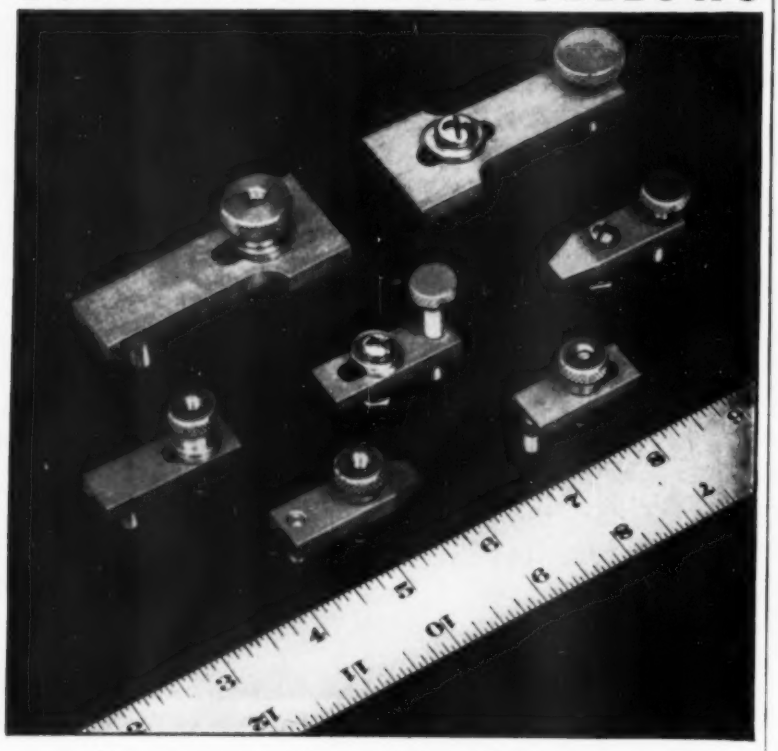

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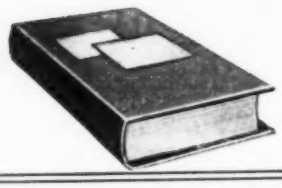

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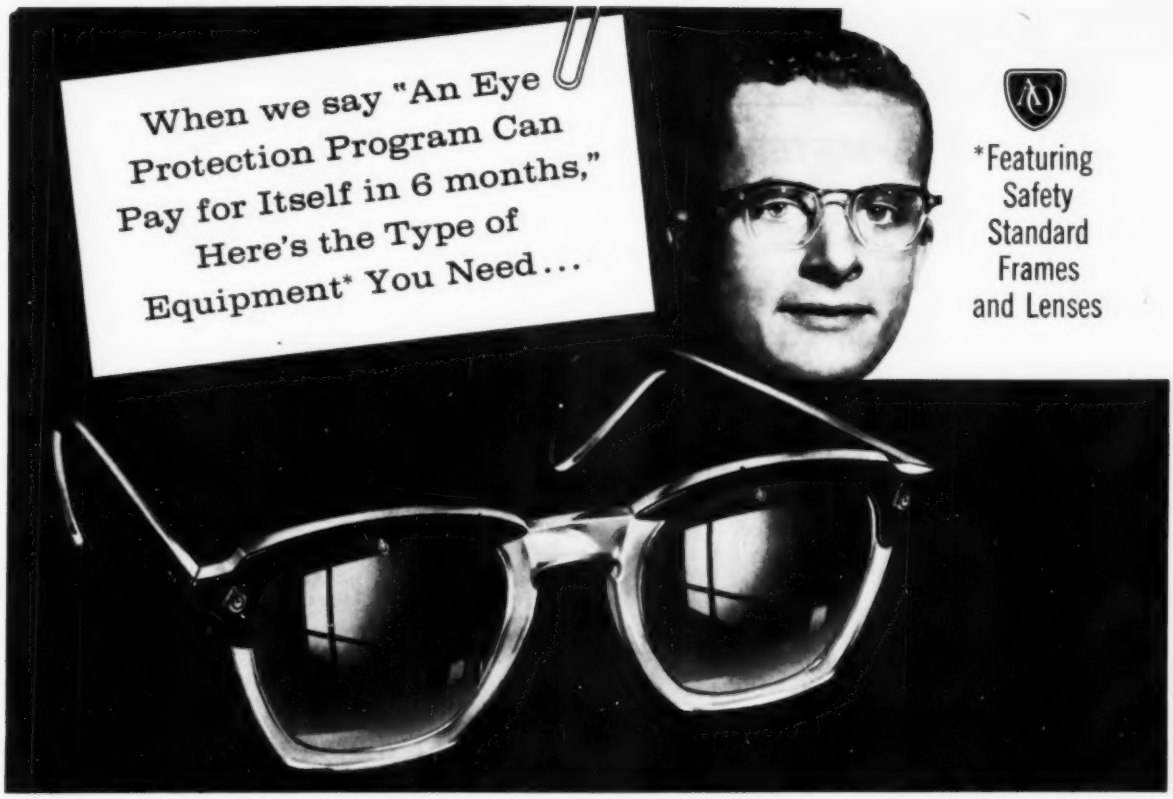
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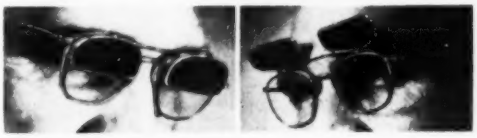

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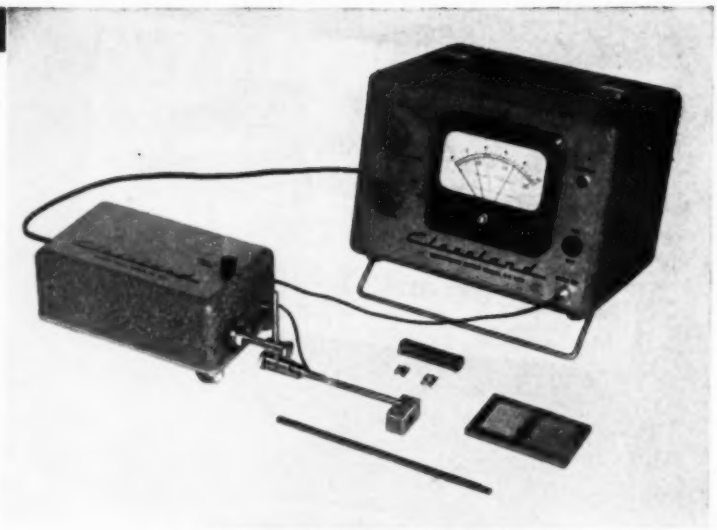

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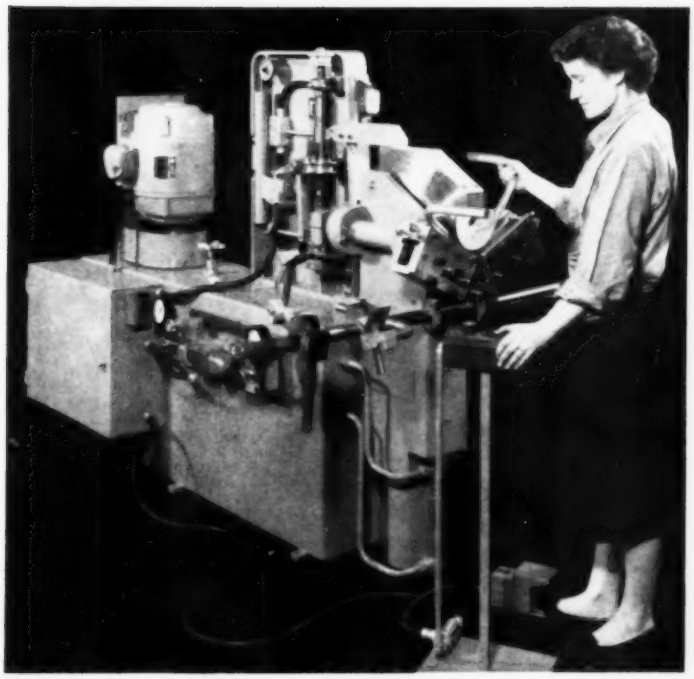

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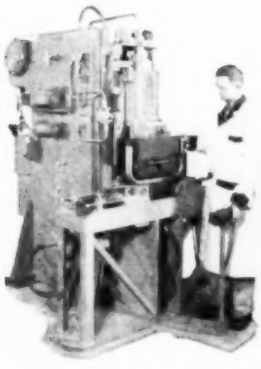
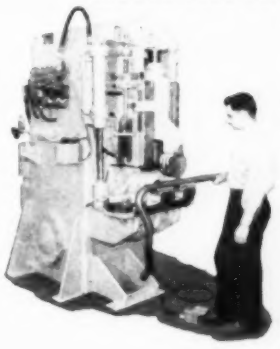
In addition to the Model 3-T, Pines also builds the larger bending presses, illustrated below, which are also establishing outstanding performance records.

MODEL 6T FOR MULTIPLE U-FRAME BENDING



Makes two bends of the same or slightly different angles in each of two or more tubes simultaneously. Production of four or more bends with each stroke makes it possible to form 1700 to 3000 bends per hour in tube sizes ranging up to 1" O.D. x .065". When necessary, retractable ram dies are used to release pieces from die grooves. Like 3-T, wing dies move with work, eliminating draw marks, producing bends of superior quality.

MODEL 1900 FOR PROGRESSIVE BENDING OF TUBES UP TO 2" O.D.



Designed for high speed bending of parts requiring a variety of bends in different planes, such as automotive exhaust and tail-pipes, or similar work. Major features are automatic angle indexing and greater working clearance which permits completing, for example, 90% of all bends in a tail-pipe with a single tooling setup. Press handles stock sizes up to 2" O.D.

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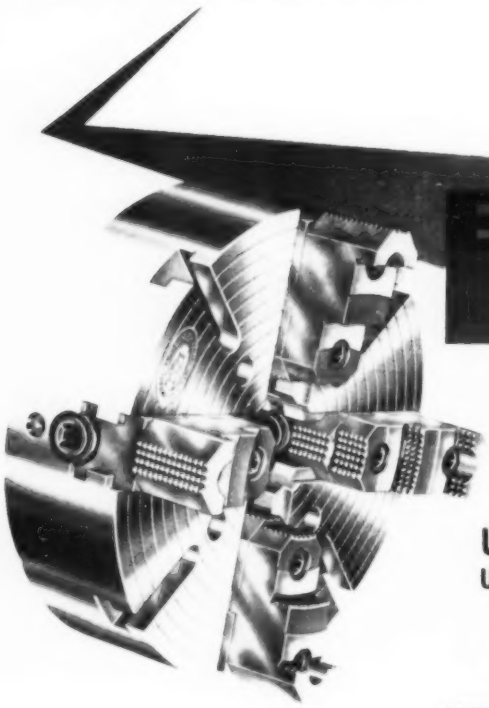

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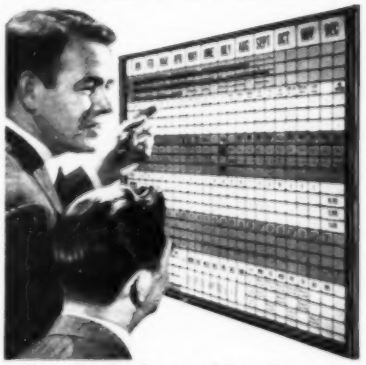

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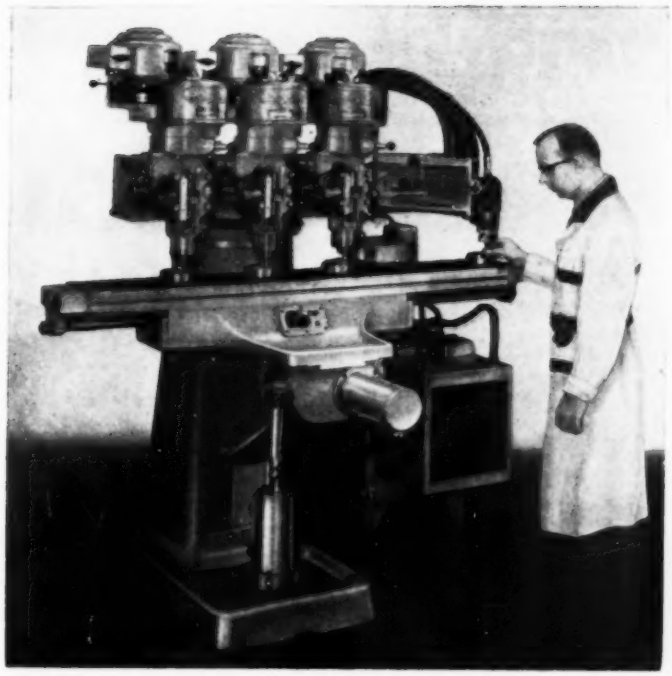

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(Left) 3D T-Ram machine with 3 milling attachments. Also available with 2 attachments. (Below) T-Ram applied to 3D Duplicating machine greatly increases its capacity.

This recent development converts the BRIDGEPORT MILLER into a duplicating machine unexcelled for accuracy, speed and ease of operation. It is designed integral with the basic machine and provides simultaneous, multiple-piece production in a single operation. Identified as the BRIDGEPORT T-Ram Tracing Machine, it is available in three models as follows:

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3D . . . with vertical, cross and longitudinal feed. Hydraulic movements: Knee 4"; Table 28"; Saddle 12".

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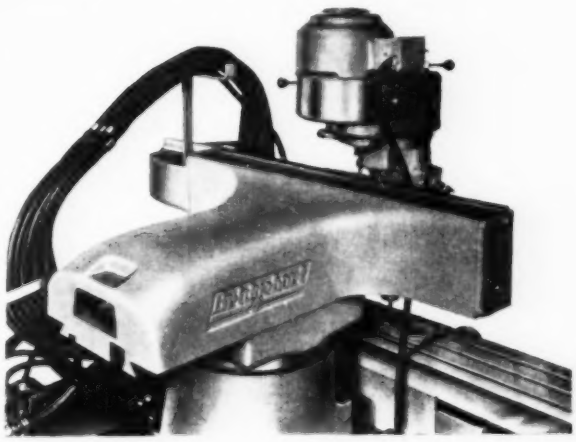

tained accuracy, smooth operation and minimum wear. A one-shot lubricating system is provided. The inherent sensitivity and accuracy of the 3D machine is achieved by combining good design with proper application of the universally-accepted True-Trace 3D valve.

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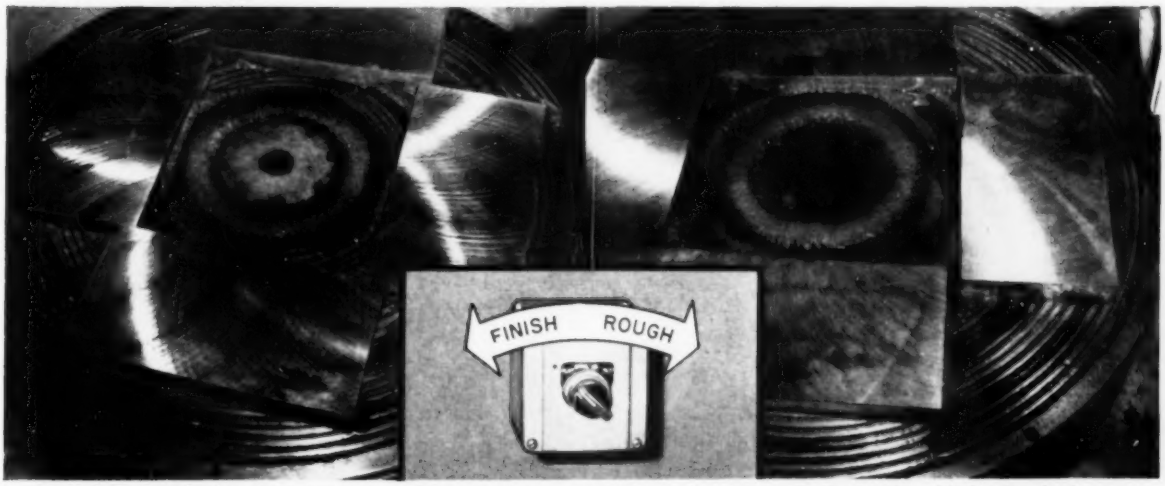


Characteristic cross-hatching shows how accurately the power-tilting device returns the wheel to the flat position.

Operator just turns the selector switch to tilt the spindle back to vertical for finish grinding and sparking out.

Harder wheels and higher downfeeds were used in roughing these large, mild steel plates on the Mattison "No. 24."

Mattison's new "Quick-Tilt" spindle changes the entire economics of surface grinding. Machines equipped with up to 60 hp spindle motors are designed to cut metal, not "scratch it." Higher downfeeds can be used to increase production by as much as 50%.

Want to replace an obsolete vertical spindle surface grinder with a machine that improves all aspects of metal removal? Here is a machine that will increase your production without compromising flatness. In fact, it probably will improve both.

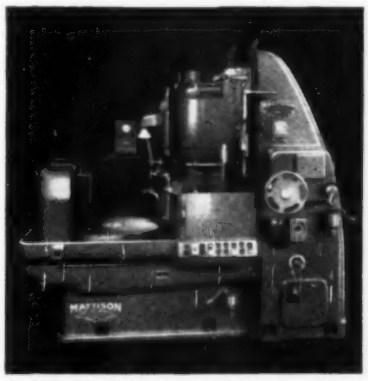
Perhaps your management wants more than an outsider's production estimate before approving a replacement proposal. Mattison will give you conclusive evidence of performance *on your job*, at no obligation other than the cost of shipping sample pieceparts to Rockford.

We will set up your parts on a grinder equipped with the most profit-significant new feature in 60 years—our automatic, power-actuated, Quick-Tilt spindle. You can see first hand, on your own pieceparts in the Mattison Methods Laboratory, how surface grinding can be changed from a "metal-scratching" operation to a profitable metal-cutting operation.

If you are a grinding man, you know that it takes pressure backed up by rigid machine construction to hog off metal with an abrasive wheel . . . and our No. 24's and 36's have more "beef" in the right places than any similar machines.

To this, we have added the Quick-Tilt spindle which really consolidates all of the advantages of power and rigidity. With the flick of a switch, you can tilt the spindle .008 to .010 in. above and below center, reducing the contact area between the wheel and the work. This permits you to start your job by taking a harder cut, grinding freely without danger of heat-checking—tearing out dull grits automatically to reduce the number of wheel dressings. This means higher downfeeds—faster production.

As your parts approach size, the automatic sizer shuts off the machine and the operator turns the selector switch to "flat." This tilts the spindle back to the true vertical position for grinding out all concavity. In less time than it takes to do a roughing operation on a conventional grinder, you get pieceparts which are dead flat on a 36" or 48" diameter.



Mattison "No. 24" has a rigid one-piece column which starts at the floor. Only the wheel head tilts.

60 hp on the No. 24

The Mattison "No. 24," with 18" capacity under the wheel (24" optional), is available with 42" table plus these important new features:

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Tell your Mattison dealer you want sample pieceparts ground in our Methods Laboratory on a Quick-Tilt machine. He will make all the arrangements for a convincing test which costs you nothing but the freight. Or, phone the factory direct.

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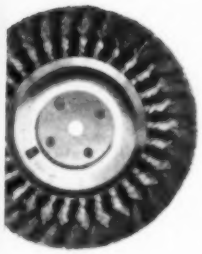

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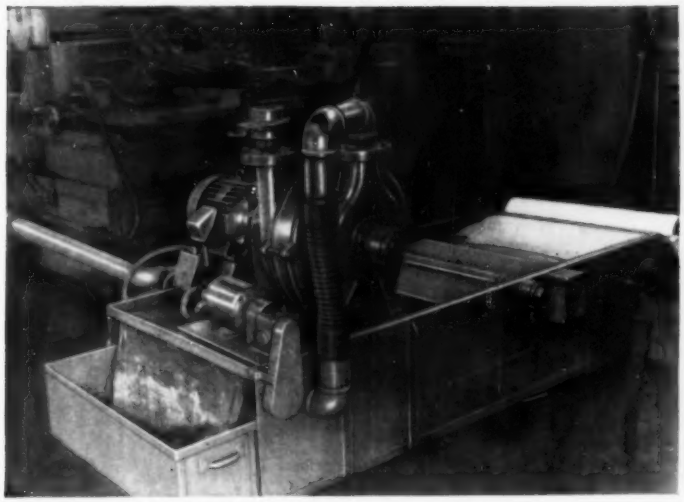
Who's Responsible for Today's High Machine Tool Costs and Obsolescence?

By: **C. A. Wallace**
Manager
Filtration Division
U. S. Hoffman Machinery Corp.



A Hoffman Vac-80 Vacu-Matic Filter is shown installed on a Norton 30" diameter stepped-wheel grinder for grinding transmission shafts at the Syracuse plant of a large automotive manufacturer.

Under present competitive conditions, production and sales crises develop swiftly. That's why many manufacturers employing machine tools are taking steps to combat the twin problems of high costs and obsolescence.

Dirty Coolants Blamed

Grinding and finishing machines originally tested for performance with clean coolants can not function near rated capacity when the coolant contains metal chips, solid abrasives, grit, dirt and fine particles. Contaminated coolant is responsible for numerous hidden expenses including shorter tool and wheel life, frequent down time for wheel dressing, tool sharpening and sump tank cleaning. Dirty coolant also means higher labor and material costs, shorter useful life of oils and coolants, poorer product finish, excessive maintenance costs, poor working conditions and more rejects. Leading tool design engineers have proven that the metalworking industry stands to gain millions of dollars annually through the use of efficient filtration equipment

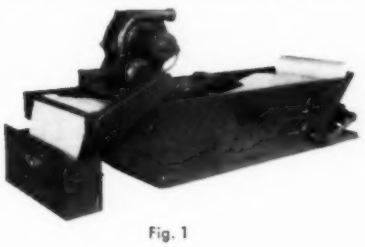


Fig. 1

such as the Vacu-Matic Filter developed by the U. S. Hoffman Machinery Corp. (Fig. 1.)

New Vacu-Matic Filters Increase Production and Cut Costs

Employing a new vacuum method, the revolutionary Hoffman Vacu-Matic Filter provides unusually high flow rates in continuous filtration of machine tool water soluble oil coolants. It is compactly designed to be used in place of the machine tool sump tank. Filter medium is a special, easily replenished paper on which solid particles are deposited. Coolant is drawn through the filtering paper by negative pressure with the dry sludge remaining on top of the paper. When sludge reaches a pre-set thickness, the filter paper is automatically indexed by a pressure differential switch and new paper moved over the vacuum area. Water-free sludge and filter paper drop off into the removable tote box for easy disposal.

Vacu-Matic Benefits and Advantages

- Removes all chips, abrasives, dirt and other solid contaminants with an overall efficiency of 98%
- Greatly reduces down time
- Protects against loading of grinding wheels
- Makes possible higher speeds, faster feeds, improved finishes, a better part at less cost
- Produces a four times greater cake than obtainable by conventional gravity flow through the paper
- Provides a 75% savings in filter paper costs
- Delivers dry sludge without coolant carry-over
- Minimizes coolant loss
- Maintains coolant at room temperature
- Effectively curtails bacteria growth
- Automatic and self-cleaning

The Hoffman Vacu-Matic is available in two models, Vac 40A and Vac 80. Vac 40A has a maximum flow rate of 40 g. p. m. for water-soluble oil coolants with a unit capacity of 50 gallons. The Vac 80 handles a maximum flow rate of 80 g. p. m. and has a unit capacity of 130 gallons.

Summing Up

With proper filtration equipment for delivering clean coolant to the work, it is possible to obtain as much as a 25% to 30% savings in cutting tools, grinding wheels, honing stones, broaches and other individual machine tools. Reduced down time and maintenance, extended useful life of coolants and lubricants, better finishes with fewer rejects, longer runs, sustained tolerances and other benefits, help amortize the costs of filtration equipment in a short time.

If you have a special filtering problem, Hoffman Filtration engineers are at your service to provide a free survey. Without cost or obligation, they'll give you objective recommendations on equipment specifically suited to your needs based on long experience in the improvement of manufacturing technology. To check on the unlimited industrial applications of the Hoffman Vacu-Matic and how it will pay for itself in your plant, send for free Bulletin FB 103, U. S. Hoffman Machinery Corp., Industrial Filtration Division, Thompson Road Plant #1, Syracuse, New York. ***New York. Dept. A-1.***

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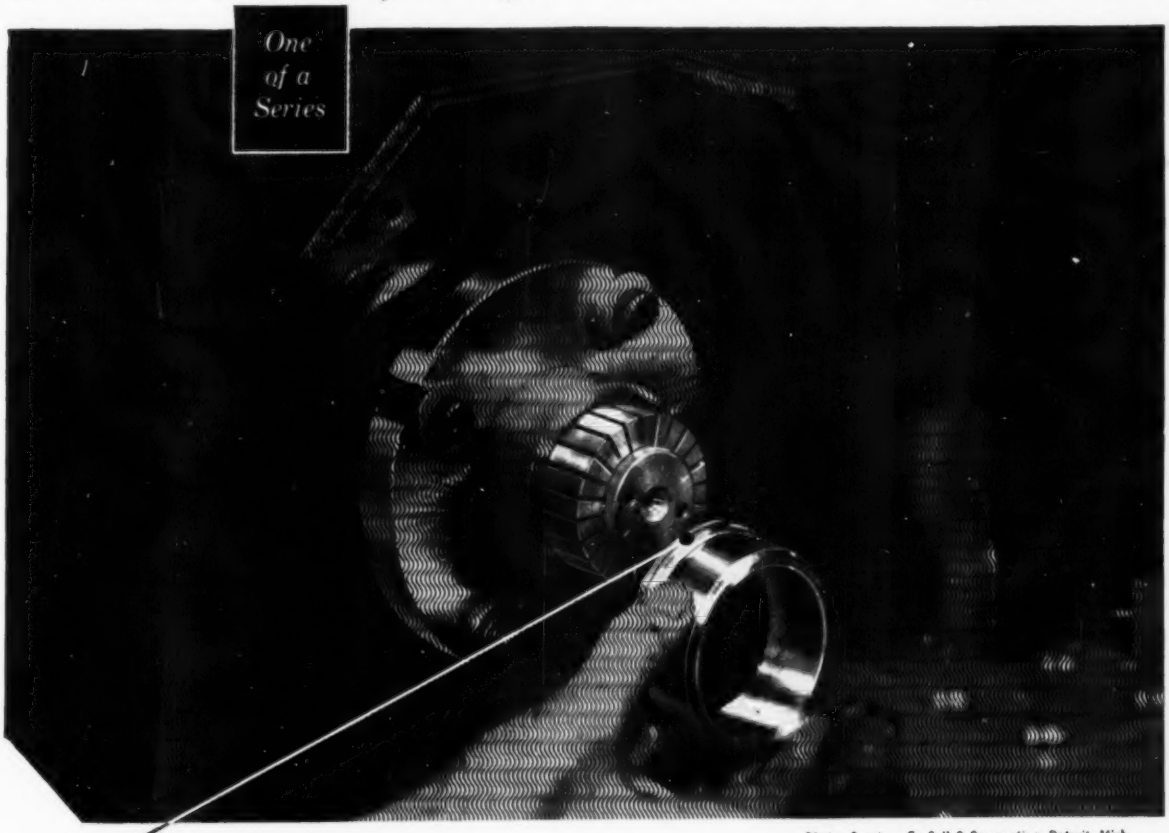

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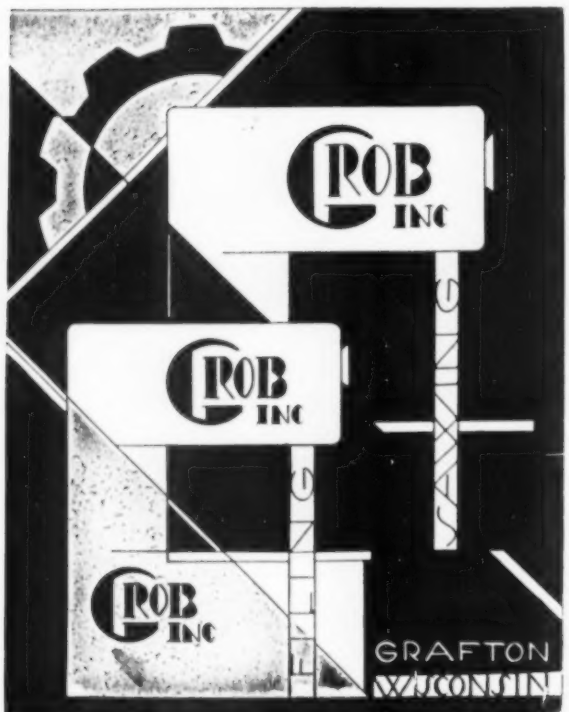

Machines for Filing, Sawing, Gear & Spline Rolling.

DESIGN SIMPLICITY? YOU BET! A CHILD COULD EASILY ASSEMBLE THIS NEW KIND OF AIR VALVE

Bodies, bases and solenoid (single or double) are standardized and interchangeable. New add-a-unit manifolds simplify wiring and installation in multiple mountings. No threaded connections, no loosening in valve body and solenoid assembly. Available in ¼", ⅜" and ½" port sizes. Write for information on our 4-way Dual-Seal air valve.

MECHANICAL AIR CONTROLS, INC.
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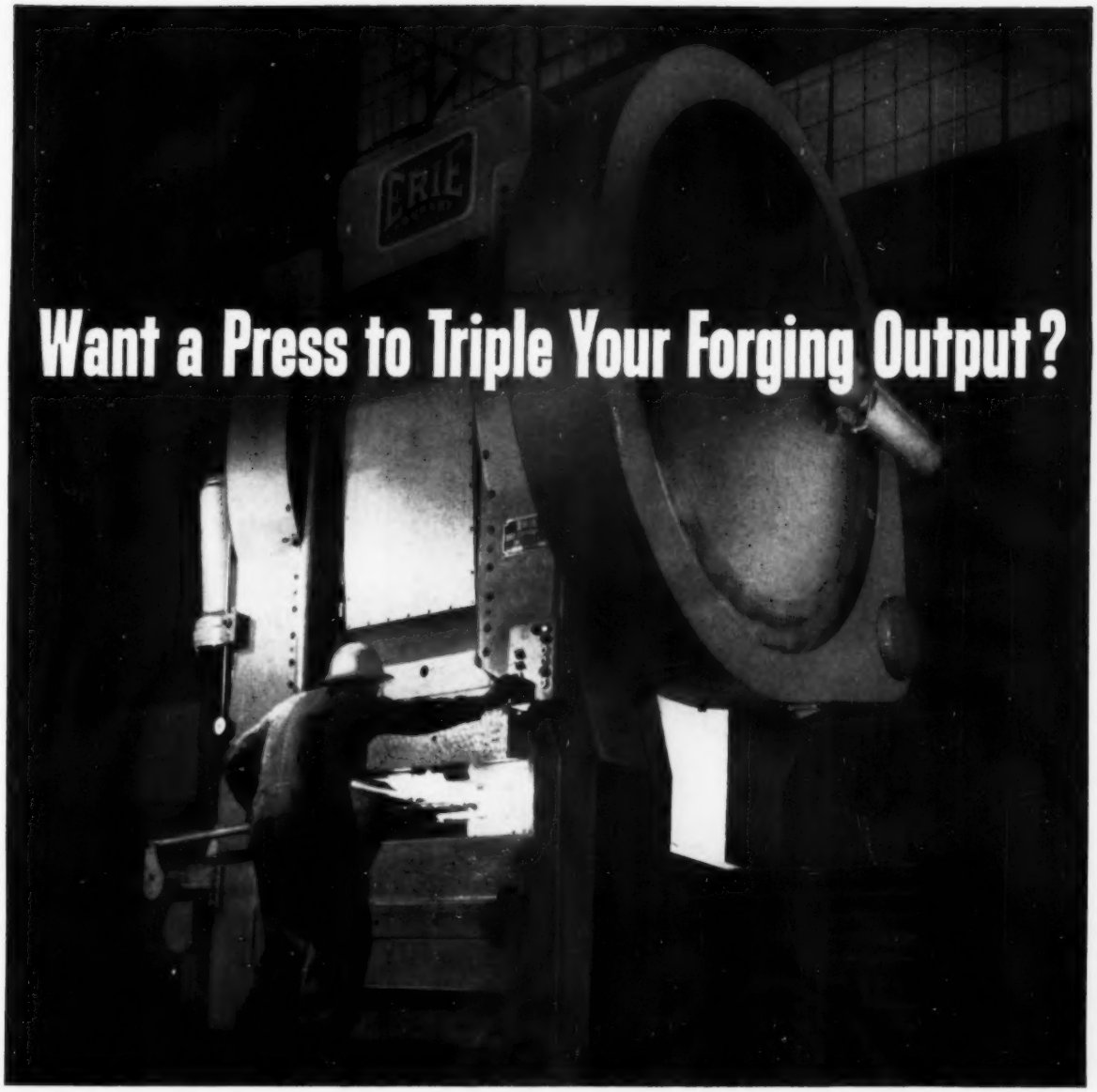

Want a Press to Triple Your Forging Output?

We'll build the press for all your forging requirements . . .

Tell us your forging problems and give us your production specifications—we'll do the rest.

Erie Foundry, one of the first companies to automate forging, can provide specially designed *high volume* presses in capacities of 1000 to 8000 tons. Instead of the three machines and nine men formerly required, now you need only one Erie automated forging press and only one operator observer—to triple your present production rate! Trimming, too, can be accomplished in a single production cycle. With billet supply and finished part removal conveyorized, it is possible to achieve a production volume of, say, 1200 track-link forgings per hour.

Erie Foundry has a complete line of machines designed for high volume production of such parts as connecting rods, gear blanks, automotive and tractor valves, pinions, track links and wheel hubs.

We would like to discuss application of automated presses to your production requirements. For the complete story, phone or write Mr. R. E. Sanford, Erie Foundry Company, Erie 5, Pa.

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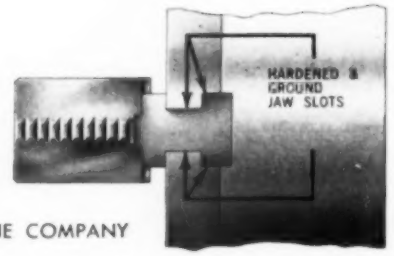
FOR THE JOB!

Whiton's universal geared scroll 3-jaw chuck is the right chuck for high-precision work and long dependable service. A major improvement over the conventional chuck, it features jaw slots formed by separate plates hardened and finish ground before mounting on the chuck body.

Whiton hardened plate type chucks available from 6" to 15" diameter for American Standard Spindle Noses; Types A, D, & L. Furnished with style No. 6 American Standard Tongue and Groove type reversible jaws.

Complete technical information available on request.



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- Thousands job-tested
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Size	Body Dia.	Drill Dia.	Drill Length	O.A.L.
#0	1/8"	1/32"	1/16"	1 1/4"
#00	5/64"	.025"	3/64"	7/8"

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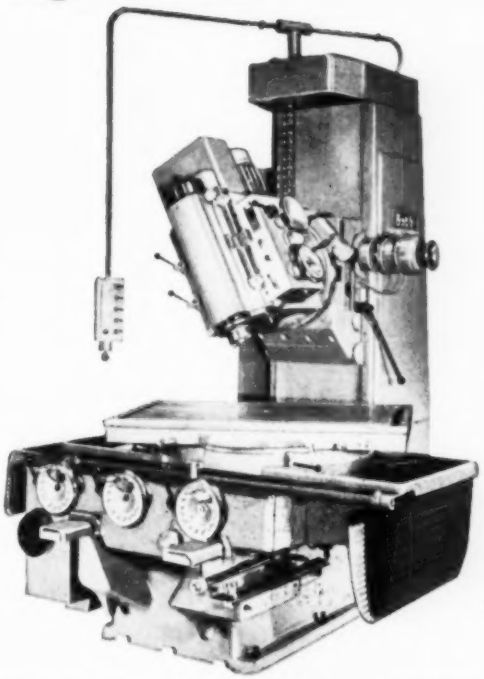
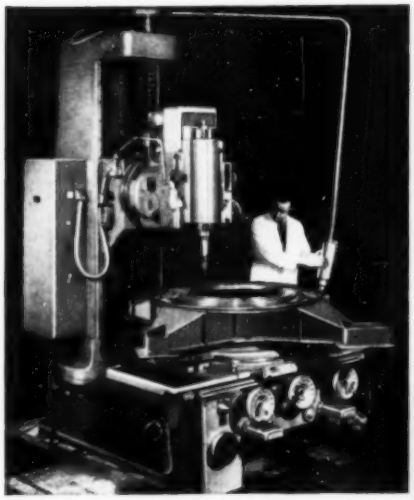
Avoid Double Handling of Large, Heavy Workpieces

with a BOKOE F3 Universal Miller

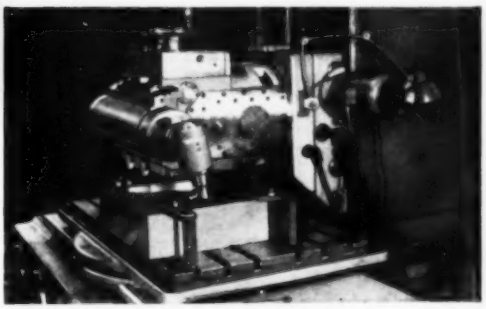


Save costly set-up time and avoid transferring bulky workpieces from one machine to another —with the BOKOE F3 Universal Milling and Boring Machine. On one, versatile machine you can now perform boring, milling and drilling—often on 5 sides—without re-setting the workpiece. The remarkably flexible operation of the BOKOE F3 is especially suited for the machining of ferrous and non-ferrous castings, dies, molds, and metal and wooden patterns. Check these many BOKOE features for *your* production needs . . .



Rotary milling on large component.

- Coordinate positioning of rotary worktable with steplessly adjustable feeds for transverse, longitudinal and rotary movements—operating either individually or simultaneously. Rapid travel for all three directions.
- Clamping area up to 63″ x 31.5″. Longitudinal movement up to 72″, transverse movement up to 28″. Maximum workpiece diameter for circular and radius milling, up to 98″. Maximum distance, main spindle to column, 48″.
- Stepless spindle speeds from 36—1800 rpm. Six spindle feeds from .0016 to .016 in./revolution. Spindle slide rotates 90° in either direction. Entire column rotates 360°.
- All electrical equipment in accordance with J.I.C. standards.



Head turned 90° with right-angle milling attachment.

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New York: April 27-29
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Chicago: May 14-16
Los Angeles: May 27-29

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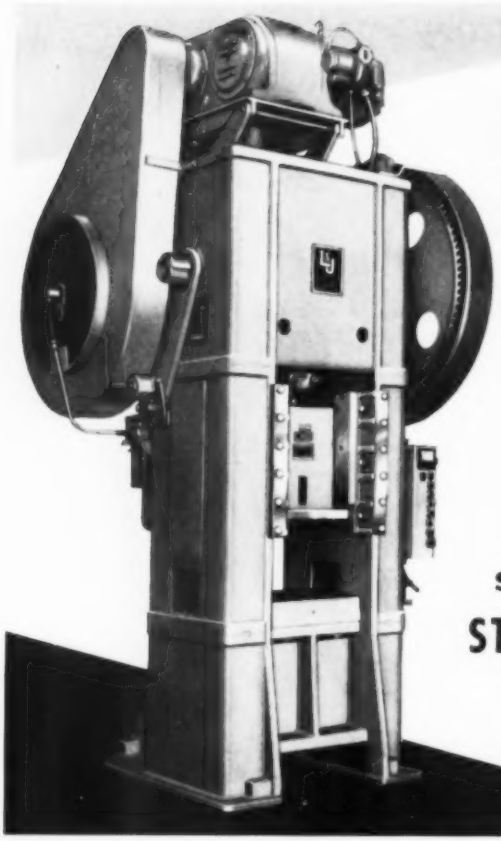

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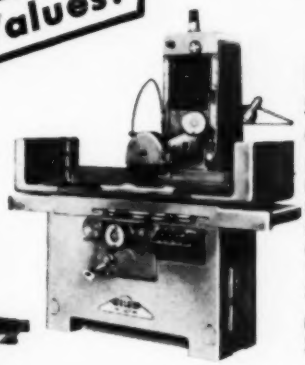
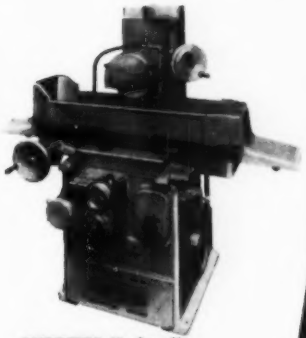
Grinding Capacity:
6" x 18" — 8" x 24"
High accuracy & Precision.



ELB SURFACE GRINDER
High Output with High Precision Direct Drive Spindle Grinding Capacity from 10" x 18" up to 54" x 236"
price from **$3730.**



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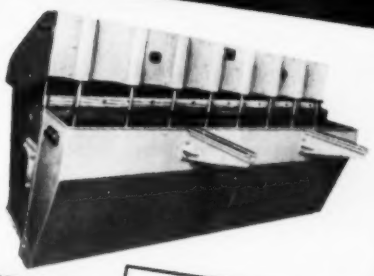
6" x 18" and 8" x 24"
price from **$2795.**



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- ALL STEEL CONSTRUCTION
- SINGLE STROKE CONTROL
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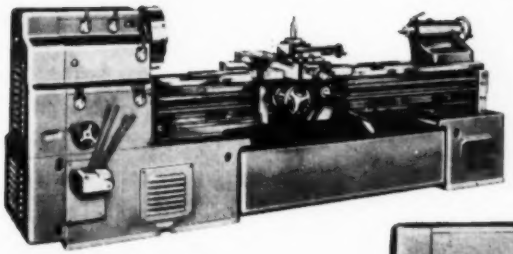
8'	12 gauge	$4395.
10'	12 gauge	$5193.
6'	3/16 inch	$5190.
8'	10 gauge	$5495.
10'	10 gauge	$5795.
6'	7/32 inch	$6190.
8'	3/16 inch	$6495.
10'	3/16 inch	$6795.

8" gaps on all models. Cuts thin and heavy gauge accurately.



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Modern, high precision Lathe, elevated output, chip pan in single piece, 2 legs. Up to 25 H.P.
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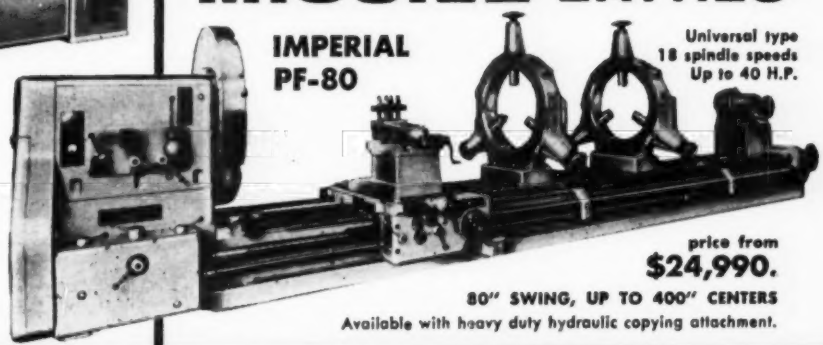
Universal type
18 spindle speeds
Up to 40 H.P.



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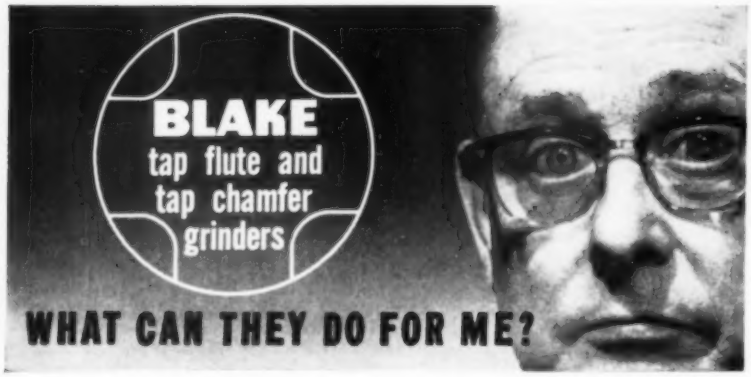

In a word, plenty.

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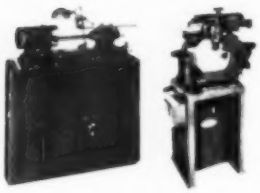
They reduce work spoilage because they enable taps to cut more accurately, more uniformly, with less strain.

They can cut your present tap costs up to 65%.

We didn't get these facts out of thin air. They come from actual case histories in metal-working plants where taps are sharpened regularly with Blake Flute and Chamfer Grinders.

These are high-precision machine tools. But they are not expensive. And they're simple enough to operate so that anyone in your plant can become accomplished at precision tap grinding with a minimum of fuss and feathers.

WANT PROOF? Just ask for it. You'll be glad you did.



Blake Chamfer Grinder Blake Flute Grinder

Blake — and only Blake Flute and Chamfer Grinders, used in combination, create or restore 1. exact indexing of cutting edges 2. controlled rake angles for each job 3. correctly ground spiral points 4. perfectly relieved chamfers . . . make one tap do work of six!

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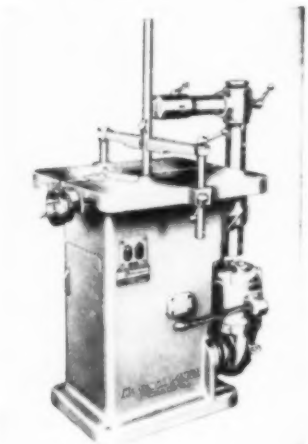

Install it in your shop. Its low cost will amaze you. Watch it pay for itself. You can quickly eliminate costly production tie-ups caused by waiting for expensive outside services. This is not an ordinary keyseater. The Morrison Keyseater is quality built with machine tool accuracy. Practically anyone can operate it. It has automatic feed, automatic stop to cut off feed at given depths, automatic relief to back the work away from cutters, automatic centering, automatic lubrication. NO BRUSHINGS REQUIRED. Cuts keyways 1/16" to 1".

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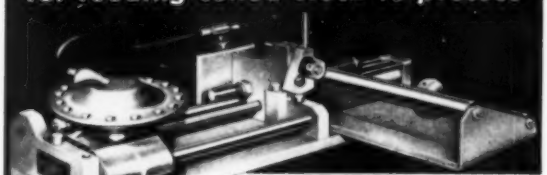
Ses-Matic AIR FEED

for feeding coiled stock to presses



Amazing in performance, outstanding for durability . . .

• Packed with power, speed, simplicity, accuracy . . . the Ses-Matic AIR FEED handles a wide range of press feeding jobs—mounts directly to the side of the press . . . simple adjustments when changing from one job to another. Models available for most stock widths, feed stroke lengths, and stock thicknesses up to .187 inches. Unit can be moved from press to press.

Write for catalog on Ses-Matic Air Feeds, Cradles, Straighteners and other coil handling equipment.

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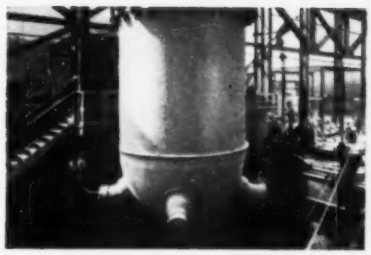

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Nuclear energy is now supplying power for ships and electric plants. Future possibilities are virtually unlimited.

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Our growing population demands constantly increasing mobility. Result: thousands of new opportunities, new jobs in the coming Jet Age.

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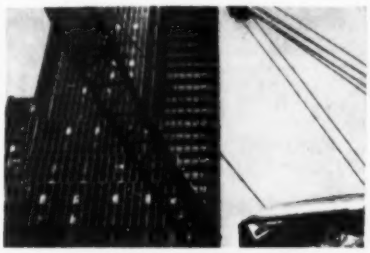
The trend is to labor-saving, ready-to-eat packaged foods. This new phase of an old industry will need thousands more workers.



CONSTRUCTION

3 million workers will benefit from new highway and construction programs—and even more workers will be needed soon.

7 BIG REASONS FOR CONFIDENCE IN AMERICA'S FUTURE

1. MORE PEOPLE—Four million babies yearly. U. S. population has *doubled* in last 50 years! And our prosperity curve has always followed our population curve.

2. MORE JOBS—Though employment in some areas has fallen off, there are *15 million* more jobs than in 1939—and there will be *22 million more* in 1975 than today.

3. MORE INCOME—Family income after taxes is at an all-time high of $5300—is expected to pass $7000 by 1975.

4. MORE PRODUCTION—U. S. production *doubles* every 20 years. We will require millions more people to make, sell and distribute our products.

5. MORE SAVINGS—Individual savings are at highest level ever—*$340 billion*—a record amount that is now available for spending.

6. MORE RESEARCH—*$10 billion* spent each year will pay off in more jobs, better living, whole new industries.

7. MORE NEEDS—In the next few years we will need more than *$500 billion* worth of schools, highways, homes, durable equipment. Meeting these needs will create new opportunities for everyone.

* * *

Add them up and you have the makings of another big upswing. Wise planners, builders and buyers will act *now* to get ready for it.

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W-T "Light-Heavyweight"

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Like the well-known 15" and 20" W-T drill presses, this new 17" unit is every inch a "Light-Heavyweight" — fast, accurate, dependable, and low in cost. It has the ruggedness and stamina to handle continuous heavy-duty production drilling—yet it's easy to move if you want to "take the tool to the work."

To suit a wide range of job requirements, this big-capacity 17" drill press is available in 76 models—floor, bench or multiple spindle units with either hand or power feed. Also, it's a natural for building low-cost automated set-ups.

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A good yardstick to determine your production "strength" is the **American Machinist Inventory of Metalworking Equipment.**

A census of all the Metalworking production equipment in the United States, the Inventory is of value to every production man.

One hundred and sixty-seven different types of equipment are listed (and cross-tabulated) by age, industry and geographic area.

The 96-page, easy-to-use statistical study enables you to compare each piece of equipment in your plant with other plants in your area, with competitive plants in your own industry or with the nation as a whole.

With today's emphasis on production efficiency, every production man should have a copy of the **Inventory of Metalworking Equipment.** Published in November, 1958, it's a valuable management tool.

How do you get a copy?

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E. W. McCABE

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BORING MILL, 60" Gisholt vert. PRT
CENTERING MACHINES, Nos. 55 & 56 Sundstrand up to 72" between centers
CHUCKERS, 675 New Britain late
DRILL, No. 262 Barnes all-geared upright, 1943
DRILL No. 20 HD Baker hydr. late
GRINDERS, C'LESS. No. 12 Landis, 1947
GRINDER, CYL. 4"x12" No. H. Landis, 1943
GRINDERS, UNIV. 14"x14" Mod. 112 Rivett
GRINDERS, CYL. 20"x72" Landis, 1943
GRINDER, INT. No. 271 Heald sizematic, 1951
GRINDER, INT. 72AS Heald, Univ., Hydr.
GRINDER, INT. No. 74 Heald Hydr., 1941
GRINDER, SURF. 6"x24" DoAll hydr. 1948
GRINDER, SURF. 20"x24" No. 25A Heald
GRINDER, SURF. 12"x16"x36" Mattison, 1942
GRINDER, SURF. 36" No. 16 Blanchard, 1936
GRINDER, CUTTER, 30" Ingersoll, 1942
GRINDER, CARBIDE, Nos. 48 and 49 Excello
GRINDER, RADIUS, No. 49 VanNorman, late
GRINDER, TOOL & CUTTER, No. 2 Cincinnati
HOB SHARPENER, Type HRS Barber Colman
KELLER, BL2416 Pratt & Whitney 3 Spdl., 1941
LATHES, ENGINE, 13", 15" & 17" LeBlond
MILLER, AUTO 2-20 Kent Owens, 1942
MILLER, AUTO 36" No. 33 Sundstrand
MILLER HAND, No. 2BV Kent-Owens, 1942
MILLERS, No. 10 & 3 VanNorman Duplex
MILLER, PLAIN, No. 2 Cincinnati HSDT, 1940
MILLER PLAIN, No. 3H K & T MSDT 1943
MILLER VERT. #2 Brown & Sharpe HSDT, 1943
MILLER, No. 36 VanNorman, ram type, 1942
ROUTERS, Type A-1R Onsrud Radial 64", late
SAW, 10"x10" Racine Hydr., Mack, 1941
SHAPER, 6" P&W vert., also 12"
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2. Automatics
3. Balancing Machines
6. Boring Mills
9. Centering Machines
10. Chucking Machines
16. Drilling and Reaming Machines
24. Grinding Machines
29. Lathes
33. Milling Machines
37. Planers
39. Press Brakes
41. Presses
47. Routers
48. Saws
50. Shears
51. Shapers
55. Thread and Tapping Machines
56. Threading Machines

ADVERTISER	PAGE NO.	KEY TO PRODUCTS OR SERVICES
Cincinnati Machinery Co.	242	16, 24, 29, 33, 51
Eastern Machinery Co., The	242	33, 37, 56
Falk Machinery Co.	242	16, 24, 29, 33, 41
Hyman & Sons, Joseph	241	39, 41, 50
Lone Star Machinery Corp.	242	2, 24, 29, 33
Miles Machinery Co.	241	3, 6, 9, 10, 16, 24, 29, 33, 47, 48, 51, 55
Paul's Machinery Co.	242	2, 33, 39, 41, 51

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INDEX TO ADVERTISERS

This index is published as a convenience to the readers. Every care is taken to make it accurate, but AMERICAN MACHINIST assumes no responsibility for errors or omissions

	Page
Aaron Machinery Co., Inc.	237
Acromark Company	226
Adamas Carbide Corp.	65
Air Reduction Sales Co., Div. of Air Reduction Inc.	56
Alemite	77
Allegheny Ludlum Steel Corp.	62
Allison-Campbell Div. American Chain & Cable Co., Inc.	40, 48
Aluminum Company of America	73
American Brass Co.	215
American Chain & Cable Co., Inc. Allison Campbell Div.	40, 48
Wilson Mechanical Instrument Div.	38
American Optical Co.	221
American Saw & Mfg. Company	208
American Sealants Company	99
American Sip Corp.	60
American Steel Foundries, Elmes Eng. Div.	187
American Tool Works Co.	41
Ames Company, B. C.	199
Armstrong Blum Mfg. Co.	74
Armstrong Brothers Tool Co.	24
Atlas Press Co., Clausing Div.	169
Avey Div. of Motch & Merryweather Co.	20-21
Baker Bros., Inc.	201
Bardons & Oliver, Inc.	197
Barnes Drill Company	161
Bearings, Inc.	163
Bellows Co., Div. International Basic Economy Corp.	212
Berthiez	58
Besly-Welles Corp.	177
Bethlehem Steel Co.	67
Bilgram Gear & Machine Co.	236
Blake Co., Edward	238
Blanchard Machine Co.	248
Bodine Corp.	39
Boston Gear Works	211
Boye & Emmes Machine Tool Co.	222
Bridgeport Brass Company	133
Bridgeport Machines, Inc.	225
Brown & Sharpe Mfg. Co.	81, 86
Buck Tool Company	246
Buffalo Forge Co.	36-37
Bullard Co.	88
Burr, John T. & Son, Inc.	247
Butterfield Div., of Union Twist Drill Co.	59

(Continued on page 244)

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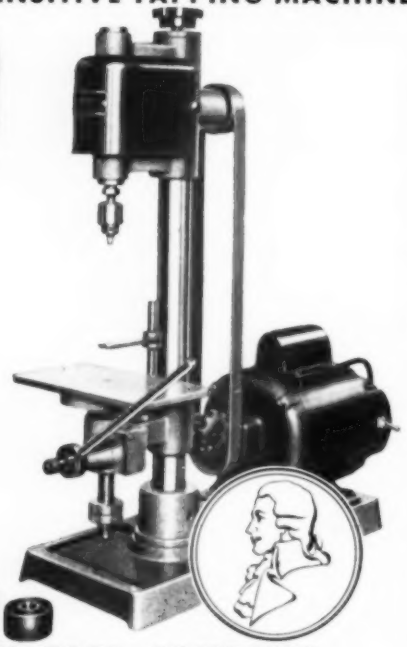

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INDEX TO ADVERTISERS

(Continued from page 243)

	Page
Century Electric Company	172-173
Chandler Tool Company	228
Chicago Screw Co.	155
Cincinnati Gear Co.	214
Cincinnati Gilbert Machine Tool Co.	76
Cincinnati Milling Machine Co. Milling Machine Division	6-7
Circular Tool Company	71
Cities Service Oil Co.	82
Clark-Cutler-McDermott Co.	219
Clausing Div., Atlas Press Co.	169
Cleveland Crane & Engineering Co.	217
Cleveland Electric Illuminating Co.	185
Cleveland Grinding Mach. Co.	230
Cleveland Instrument Co.	222
Columbus Die-Tool & Machine Co.	190
Commercial Filters Corp.	68
Copperweld Steel Co. Ohio Seamless Tube Div.	55
Cosa Corp.	235
Covel Manufacturing Co.	162
Crane Packing Co.	206
Cross Company	28-29
Danly Machine Specialties, Inc.	134
Davis & Thompson Co.	247
Delta Power Tool Div., Rockwell Mfr. Co.	175
DeVilbiss Company	171
Dixie Bearings, Inc.	163
DoAll Company	203
Drillmation Co., Inc.	167
du Mont Corp.	78
Elmes Engineering Div., American Steel Foundries	187
Engelberg, Inc.	168
Erickson Tool Co.	231
Erie Foundry Co.	233
Etco Tool & Machine Co., Inc.	186
Ex-Cell-O Corporation	54
Farquhar Div., A. B. Oliver Corp.	207
Fawick Airflex Div., Fawick Corp.	153
Federal Pacific Electric Co.	92
Fellows Gear Shaper Company	8-9
Filmsort Co. Div. Miehle-Goss-Dexter, Inc.	232
Gardner Machine Co.	25
Gates Rubber Company	166
German American Trade Promotion Office	224
Gisholt Machine Company	43
Gleason Works	47
Goss & de Leeuw Machine Company	210
Graphic Systems	224

INDEX TO ADVERTISERS

	Page
Graymills Corporation	178
Greenless Bros. & Company	90
Grob, Inc.	232
Hamilton Tool Co.	244
Hannifin Co., Div. Parker-Hannifin Corp.	157
Hardinge Brothers, Inc.	69
Hartford Machine Screw Co.	155
Heald Machine Co., Sub. Cincinnati Milling Machine Co.	2nd Cover
Hones, Inc., Charles A.	182
Houghton & Co., E. F.	5
Industrial Distributors (Sales) Ltd.	57
Infilco, Inc.	230
Inland Steel Company	170
International Business Machines	226
Jahn Manufacturing Co., B.	174
Jones & Lamson Machine Co.	30, 46
L & J Press Corp.	236
Landis Machine Company	10-11
Landis Tool Company	12-13
La Pointe Machine Tool Co.	26-27
Latrobe Steel Co.	183
LeBlond Machine Tool Co., R. K.	32-33
Leland-Gifford Company	79
Lincoln Electric Company	205
Linley Brothers Co.	220
Lipe Rollway Corp.	196
Lodding, Inc.	220
Lodge & Shipley Co.	61
Logan Engineering Co. (Lathe Div.)	179
Lovejoy Tool Co., Inc.	198
Lufkin Rule Co.	84
M. B. I. Export & Import Ltd.	192
Mackintosh-Hemphill Div., E. W. Bliss Co.	138
Malleable Casting Council	51
Mattison Machine Works	227
McGill Mfg. Co.	158
McGraw-Hill Book Co., Inc.	220
Mechanical Air Controls Inc.	232
Metallurgical Products Dept., General Electric Co.	100
Micrometrical Mfg. Co.	180
Milford Rivet & Machine Co.	186
Minneapolis Honeywell Regulators Co. Machine Control Div. Servo Valve Amplifiers	64
Mitts & Merrill	245
Modern Devices Sub. Twentieth Century Mfg. Co.	176

(*Continued on page* 246)

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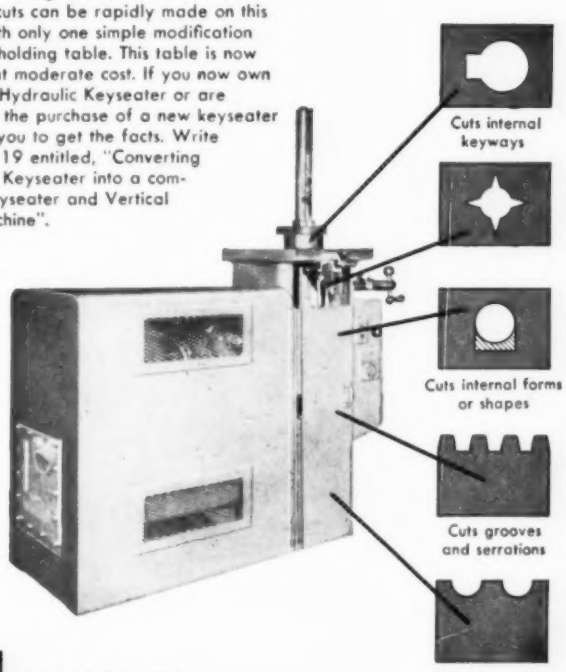

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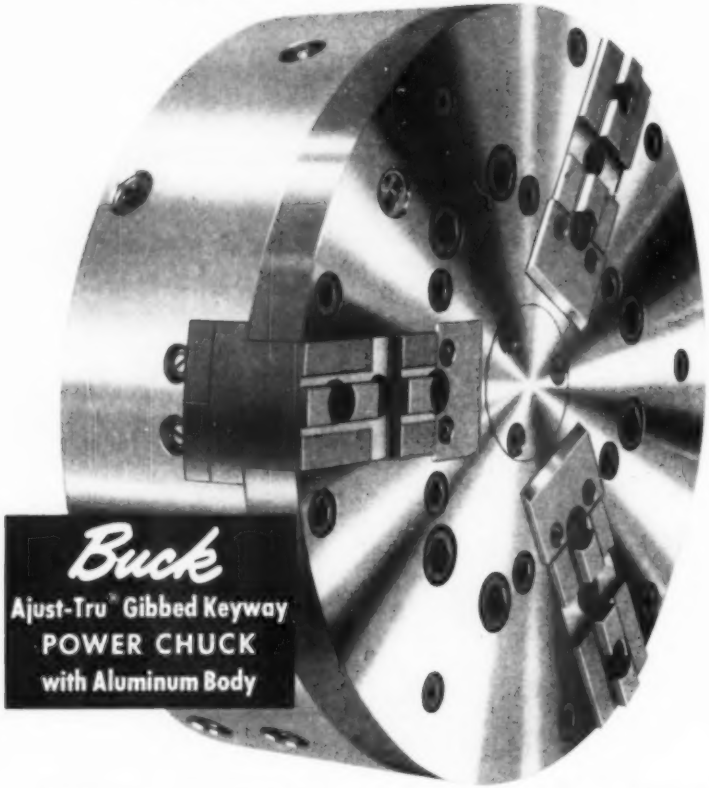

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INDEX TO ADVERTISERS

(*Continued from page 245*)

	Page
Monarch Machine Tool Company	63
Morrison Co., D. C.	238
Morse Twist Drill & Machine Co.	14-15
National Acme Co.	34-35
Nelco Carbide Tools	81
New Method Steel Stamps, Inc.	232
Nicholson File Company	42
Nilson Machine Co., A. H.	195
Norgren Company, C. A.	52-53
Northfield Foundry & Machine Co.	222
Norton Company	18-19
O K. Tool Co., Inc.	66
Oakite Products, Inc.	200
Ohio Crankshaft Company	49
Ohio Department of Commerce	159
Ohio Seamless Tube Div., Copperweld Steel Co.	55
Oliver Corp., A. B. Farquhar Div.	207
O'Neil-Irwin Mfg. Co.	189
Parker Hannifin Corp.	157
P I C Design Corp.	238
Pines Engineering Co., Inc.	223
Pittsburgh Plate Glass Company	228
Pittsburgh Screw & Bolt Corp., Southington Hardware Div.	236
Radio Corp. of America Industrial Automation Equipment	44-45
Randall Co., Inc., Frank E.	228
Rivett Lathe & Grinder, Inc.	83
Rockford Machine Tool Company	164-165
Roto-Finish Company	181
Rotor Tool Company	102
Ryerson & Son Inc., Joseph T.	94
Sciaky Bros, Inc.	193
Sheldon Machine Company	226
Simonds Gear & Mfg. Co.	204
Simonds Saw & Steel Co.	96
Skinner Electric Valve	218
Special Engineering Service, Inc.	238
Square D Co.	194
Standard Screw Co.	155
Starrett Co., L. S., The	140
Steelweld Machinery Div. Cleveland Crane & Engineering Co.	217
Stewart-Warner Corp.	77
Sulflo, Inc.	245
Sundstrand Machine Tool Co.	22-23
Tannewitz Works	228
Thompson Grinder Company	191
Threadwell Tap & Die Corp.	72
Timken Roller Bearing Co.	4th Cover

INDEX TO ADVERTISERS

	Page
Union Mfg. Co.	224
U. S. Hoffman Machinery Corp.	229
U. S. Tool Co., Inc.	3rd Cover
Universal Engineering Co.	209
Van Keuren Co.	80
Vascaloy-Ramet Corp.	151
Verson Allsteel Press Co.	70
Vickers Inc.	75
Vlier Engineering Corp. Sub. Barry Controls Inc.	136
Wales Strippit Company	202
Walker-Turner Div. Rockwell Mfg. Co.	240
Warner & Swasey Co.	16-17
Weldon Roberts Rubber Co.	178
Wells Mfg. Co.	184
West Point Mfg. Co.	182
Western Automatic Machine Screw Co.	155
Wheelock Lovejoy & Co., Inc.	216
Whiton Mfg. Co.	234
Wilson Mechanical Instrument Div. American Chain & Cable Co., Inc.	38
Winslow Product Engineering Corp.	243
Woodruff & Stokes, Inc.	234
Wyckoff Steel Co.	188
Wysong & Miles Co.	31

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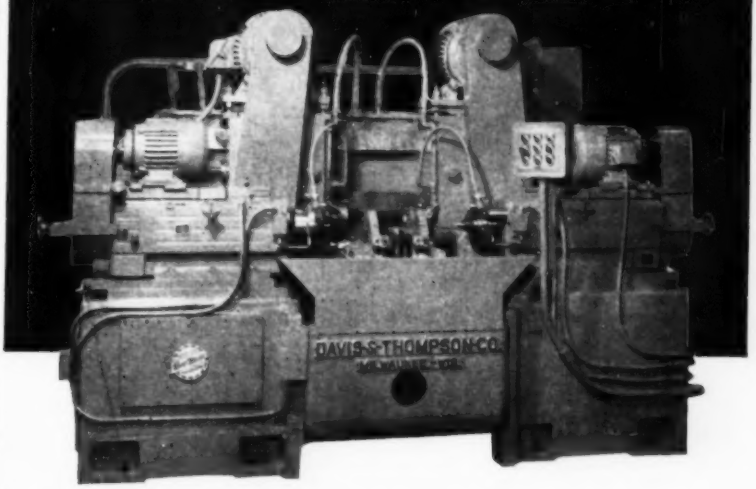

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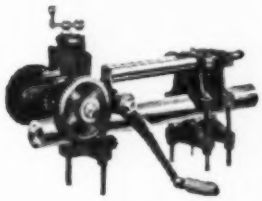

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20	42	64	86	108	130	152	174	196	218	240	262	284	306	328	350	372	394	416	438	460
21	43	65	87	109	131	153	175	197	219	241	263	285	307	329	351	373	395	417	439	461
22	44	66	88	110	132	154	176	198	220	242	264	286	308	330	352	374	396	418	440	462

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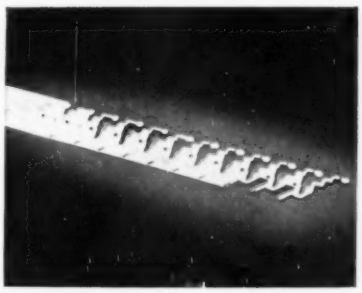

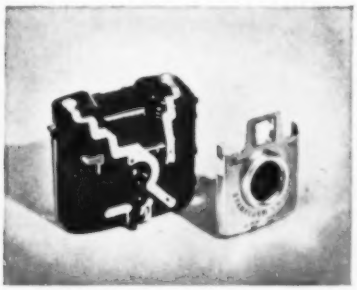

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ILLUSTRATED ABOVE: The popular Kodak Brownie Starflash Camera . . . **LEFT TO RIGHT**: Successive stages in the production of Brownie Starflash Battery Connectors as stamped by U. S. Model #33 Multi-Slide . . . Brownie Starflash Camera disassembled (built in flash removed) to show location of battery connector produced on a #33 U. S. Multi-Slide, part of flash synchronization circuitry . . . U. S. Multi-Slide Model #33 in use at Eastman Kodak Company's Apparatus & Optical Division in Rochester, New York . . . Machine is turning out battery connectors for the Brownie Starflash Camera.

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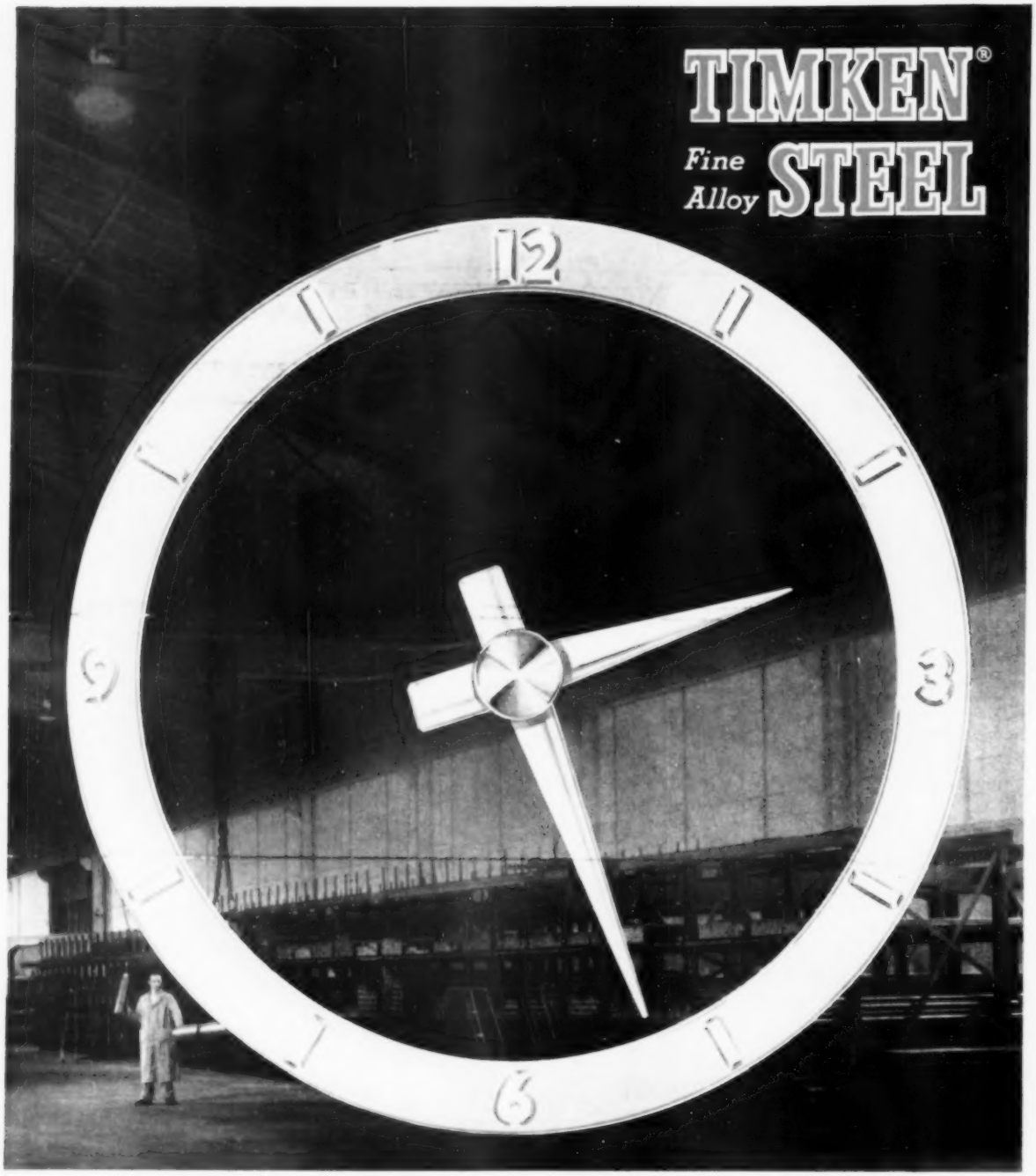

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